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Original article

The Effect of Acetic Acid Priming on Germination and Sprout Ability of Faba Bean (*Vicia faba* L.) Seeds

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Abstract

This research was carried out in Ondokuz Mayıs University germination laboratory and research field in 2019 to determine the effects of acetic acid on the germination and sprout ability of seeds of Lara faba bean (*Vicia faba* L.). Two laboratory trials were established according to the randomized plot design with 3 replications, and one field trial was established according to the randomized block design with 12 replications. The research examined germination rate, germination power, sprouting rate and sprouting power were examined. The effect of soaking in distilled water or 4% acetic acid for half an hour on the germination and sprouting abilities of faba bean seeds was not found to be statistically different. However, it has been concluded that it is beneficial to investigate how it will affect oil-borne diseases and subsequent development.

Keywords: Faba Bean, Acetic Acid, Seed Priming, Sprouting Power.

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INTRODUCTION

Regarding climate demands, the faba bean is in the group of cool climate legumes and it can be easily grown especially in the coastal areas of our country. It is important to optimize the growing conditions together with the identifying of cultivars with high yield potential. The first stage of high-yield and high-quality production is optimum germination of sown seeds, optimum plant density per unit area and sufficient development.

Thanks to studies on the yield, quality and medicinal values of this plant, which has many benefits, its agricultural, nutritional, medicinal and economic benefits will increase. Along with seed genetics, which is one of the most basic inputs of agricultural production, it is affected by environmental conditions that affect yield and quality at every stage of the crop production cycle. The first stage of high-yield and high-quality production is the optimal germination of the sown seeds. As well as determining the seed with genetic characteristics that adapt to the production purpose and regional conditions, preserving the potential seed vigour, using seeds with high seed vigour to sowing and treatments that support the decreased seed vigour with germination, are the most natural and inexpensive way to increase yield and quality in agricultural production. Therefore, studies are important on treatments that support germination, which is the first stage of plant growth (Oğuz and Bozoğlu, 2022). The preliminary treatments made to the seed are called priming to accelerate germination by initiating the metabolic activity of the seed to support the exit and plant development.

Acetic acid (CH_3COOH) is a corrosive organic acid. It is formed in nature by the oxidation of carbohydrates.It is completely soluble in water.It is found in ocean water, oilfield brine, rain, and in trace amounts in many plants and animal liquids. Any sugar-containing sap or juice can be transformed to dilute acetic acid by bacterial or fungal processes. It is known for giving vinegar its sour taste and pungent smell. Vinegar usually contains 4-5% acetic acid, but in vinegar used for pickling, this ratio reaches 18%. The acidic environment created by vinegar prevents the proliferation of most microorganisms that will cause food spoilage (Anonymous, 2019; Wagner and Staff, 2000). It is recommended to treat the seeds with vinegar before planting as an alternative to prevent various factors that may occur during germination and emergence that may adversely affect the yield and to increase seed strength, and the effects of acetic acid in vinegar are revealed by research (Oğuz 2022). Borgen and Nielsen (2001) investigated the effect of acetic acid treatment on seed infection. Increased doses of acetic acid (%5, 10, 20, 30, 99.9) and different quantities (5, 10, 20, 30, 40, 50 ml/kg)on seeds, a negative effect on seed strength proportional to high doses was observed. In winter wheat, using 5% acetic acid at a dose of 20 ml kg^{-1}, common spreading was controlled by 96% and 92%, respectively, without any negative effect on seed vigour. However, it has been reported that the germination power is significantly reduced in higher doses of 30 ml kg^{-1} and 40 ml kg^{-1} use. Dorna et al. (2018) carrot (*Daucus carota* L.)reported that acetic acid effectively controlled the carrot seed infection and did not adversely affect

seed germination but the seed vigour decreased at the highest dose (2%). Karut et al. (2019), in tomato *(Solanum lycopersicum* Mill.) examined the effect of sodium hypochlorite and vinegar on the destruction or reduction of seed-borne bacteria (*Cmm)* that cause bacterial cancer and wilt disease*;* concluded that vinegar treatments can be used as seed treatment against *Cmm*in conventional and organic farming. Elezz and Ahmed (2021), bleach and vinegar faba beans *(Vicia faba* L.*)* and lentil *(Lens culinaris* L.*)* seeds in the germination test to examine the effect; seedling growth inhibition was observed by increasing the treatment dose of both bleach and vinegar, with maximum inhibition recorded at 0.5% followed by 0.1% for both legume seeds, a positive effect was found with lower doses. In addition, the germination percentages of both faba beans and lentils were higher in vinegar than in bleach.

There has been an increasing focus on the environmental side effects of synthetic pesticides and the need for studies to reduce the amount of pesticides used or replace them with naturally occurring substances. Synthetic pesticides are not used in organic farming, and seed-borne diseases can be a severe problem here. As a cheap and environmentally friendly treatment, instead of traditional fungicides, the possible side effects of acetic acid, especially on seed germination and plant growth, should be examined, as well as its effect on preventing seed infection. The research aim is to investigate the effect of acetic acid treatment, which can be an alternative for controlling seed-borne diseases, on seed germination and seedling growth ability.

MATERIAL and METHOD

To observe the effects of acetic acid on seeds, 2 laboratory trials and one field trial were conducted sequentially. Laboratory trials were carried out at room temperature (15-25 ^{o}C). OMU Faculty of Agriculture research and trial area soil where the experiment was conducted is clayey, salt-free (EC=376.00 ms/cm), pH neutral (6.30), organic matter (1.88%), high P content (56.52 ppm), Ca 33.3 mEq, Mg 12.6 mEq, K 1.15 mEq, Na 1.64 mEq per 100 g were determined. There is a humid and temperate climate in Samsun. According to the data of many years, while the total amount of rainfall was 504.6 mm in the vegetation period, 478.3 mm of rainfall fell in the year. The sowing was made November 22, 2019 and 62.8 mm of precipitation fell this month, and 77.8 mm in December. Before sowing and in December, the rainfall that saturated the soil with water and coincided with the interval between the germination and the sprouting period was sufficient, and extra watering was not considered necessary. In the period in which the trial was carried out, the lowest temperature was experienced in January and was 0.8 ^{o}C higher than in long years. November-December, the average temperature is calculated at 13.2 ^{o}C. In the research, the seeds of the Lara variety harvested in the same year were used. The trials were established; 3 reps for the laboratory and 12 reps for the field.

1. Laboratory trial: The seeds, which were kept in distilled water (100 ml) and 4 different acetic acid doses (4% and its multiples 8%, 12%, 16%, taking into account the ratio of acetic acid in vinegar content) for 24 and 48 hoursas priming, were placed in 4 rows (20 seeds) equally spaced, 5 on a row, on

the germination base with cotton between two germination papers. The base soaked with holding liquids was carefully rolled so that the seeds remained inside. The rolls were placed in airtight nylon bags. Fourth and fourteenth- day values were recorded as germination rate and germination power.

2. Laboratory trial: The seeds, which were kept in distilled water (100 ml) and2 different acetic acid doses (4% and 10 times higher 40%) for 1/2 hour as priming, were placed in 5 rows (50 seeds) at equally spaced, 10 on a row, on the germination base with cotton between two germination papers. The base soaked with holding liquids was carefully rolled so the seeds remained inside. The rolls were placed in airtight nylon bags. Fourth and fourteenth-day values were recorded as germination rate and germination power.

For field trial: The seeds, which were kept for half an hour in 3 different doses of acetic acid (0%: control: distilled water, 4% and 40%), were sown in 4 rows x 20 = 80 seeds at equal distances. The holding liquids were poured into the soil along with the sown seeds. Two exit observations were taken. The first count (sixteenth day) was recorded as driving speed, and the second count (thirty-sixth day) as driving force values.

Variance analysis was performed by using SPSS package program for the data of the germination values of the seeds kept for half an hour in the doses. According to the F test, the difference between the treatments was significant ($P<0.01$). LSD test was performed to group treatments.

RESULTS and DISCUSSION

According to the observations and data obtained in the research, the use of acetic acid in the first laboratory trial showed an inhibitory effect on infection. However, germination was not observed at 4 doses of acetic acid. In control, the germination rate was 70% and 90% in 24 and 48 hours, respectively, and the germination power was determined to be 100% in both, but seed infection was observed (Table 1). Based on the fact that the 4% AA dose is effective against infection and the treatment time may have been too long, the duration was determined to be 1/2 hour in the second laboratory trial. In the 2. laboratory trial, the germination power averages were 87% in control and 7% in the 4% AA treatment were very low (Table 1). The second laboratory trial showed that germination is not observed when waiting for 24 hours at a dose of 4% AA, while germination occurs when waiting for 1/2 hour.

Table 1. Germination rate and power of faba bean seeds of holding for different time and liquids

	Holding Liquid (100 ml)					
	Distilled Water			**%4 AceticAcid**		
Holding Time (hour)	**48**	**24**	**½**	**48**	**24**	**½**
Germination rate (%)	90	70	81	0	0	17
Germination power (%)	100	100	87	0	0	7

Both laboratory and field trials show that acetic acid negatively affects the seed vigour, but this effect is less in the field trial. We think that the negative effect of acetic acid on seeds may have been tolerated by the effect of nutrient elements in the soil. In addition, the ratio in vinegar is 4% AA and its 10 times higher dose 40% AA treatment has been tried in the field.Although 40% AA, which was tried in the field as an overdose, weakened the riding power, output and plant growth were observed even at this dose.

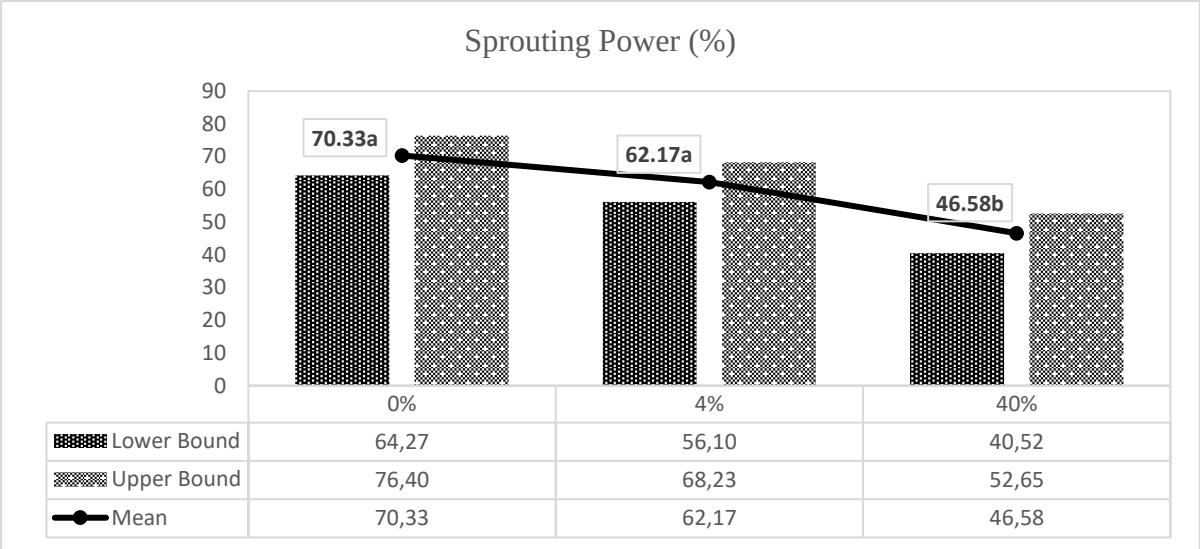
According to the analysis of variance, it was found that the treatments had a very significant ($P<0.01$) effect on the sprouting rate and power. In both, the control and 4% AA fell into the same group, and the values were the lowest at 40% AA (Table 2).

Table 2. Sprouting rate and power values of Lara faba bean seeds kept in different acetic acid doses

	Sprouting Rate **				**SproutingPower ****			
Treatment	**Mean**	**Std. Error**	**95% Confidence Interval**		**Mean**	**Std. Error**	**95% Confidence Interval**	
			Lower	**Upper**			**Lower**	**Upper**
0%	7.67 a	0.428	6.80	8.54	70.33 a	2.22	64.27	76.40
4%	7.50 a	0.428	6.63	8.37	62.17 a	2.22	56.10	68.23
40%	5.58b	0.428	4.71	6.45	46.58 b	2.22	40.52	52.65

**P<0.01

As a result, it was concluded that the effect of 4% AA on the sprouting abilities of seeds is not statistically different from the control, but it is useful to research it, especially to determine how it will affect soil-borne diseases and subsequent development.



Not enough information has been obtained on the subject, and previous research has generally focused on the use of acetic acid for disinfection purposes. For this reason, the faba bean seed structure has been discussed with the literature in selecting treatment time and dose. Faba bean seeds are large and thick-shelled compared to wheat and vegetable seeds examined in the resources. Considering that the seed structure, wishes and response of each genotype to treatments will be different, trials should be continued to determine the appropriate retention time and dose option. Various elements in the seed begin to seep into the water after a while. Therefore, in order not to be wasted, the holding liquids were poured into the sowing medium for watering together with the sowing of seeds. If the seeds are sown after straining without pouring the holding liquids into the medium, the result may be different.

In addition, it is also necessary to determine the possible effects of acetic acid treatment, which can be an alternative to prevent seed-borne diseases, on parameters such as seed germination ability, plant growth, agro-morphological characteristics and quality characteristics. Acetic acid, and other treatments with proven positive effects in organic farming, can be a low-cost, eco-friendly and adequate seed treatment.

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