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The effects of seed priming with cattle fecal extract on seed germination of Coriander (*Coriandrum sativum*)

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Abstract The different of cattle fecal extract concentration was used for seed priming of coriander. The results showed that seed primed had germinated 2.5 times higher than no primed. The seeds that primed with 60 % concentrate of cattle fecal extract was the best in term of, lowest of mean germination time, highest germination, and normal seedling. It is recommended that farmers should seed priming before seeds sowing into the field using 60 % concentration of cattle fecal extract.

Keywords: Seed priming, Coriander, Seed germination, Cattle fecal extract

Introduction

Coriander (*Coriandrum sativum*) is a very popular spice and medicinal herb, which is now planted by many gardeners or herbal enthusiasts. This plant is an important vegetable plant crop in Thailand. It isn't only widely used in Thai dishes but also effected to human health as a function of the medical plant. The stems, leaves, roots, and seeds are all used in cooking. The foods are seasoned with coriander roots, which are said to be as different in flavor as the leaves from the seeds. Coriander leaves are used to flavor many foods in Thai. The leaves are great for Thai soups (such as Tom Yam Gung), rice noodle dishes (such as Phat Thai, Mi Krop), poultry and fish dishes, and seafood or glass noodle salads. While their seeds that rich in oil and were used for medical. Now a day, based on the signs and symptoms of infectious respiratory disease caused by COVID-19, coriander is one of the plants that have been introduced for acute respiratory infection (Moslemi *et al.*, 2020). This reason caused the herb's price to rise to 400 baht per kilogram (Bangkok Post, 2021). Coriander is an annual herb that belongs to the family Apiaceae (Umbelliferae). The root of the plant has a main root with only a few lateral roots. The stem of Coriander is a typical annual herb that can reach heights of growth between 30 and 130 cm. The leaves of coriander have a different shape depending on age. The young leaves appear round and slightly stilted. They have a distinctly rich green to light green color, while the older coriander leaves are

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typically fragile and distinctly notched. The small flowers are pink or whitish and are borne in umbel clusters. The fruit is a small dry schizocarp consisting of two semiglobular fruits joined on the commissural or inner, sides, giving the appearance of a single, smooth, nearly globular fruit about 5 mm (0.2 inches) in diameter (Sahib *et al*., 2013). According to the umbel inflorescence, which is the indeterminate plant, means the fruits not set all ripen at once that caused the quality of seed vigor. The seed priming is seeds treatment before sowing. This is the method of controlled hydration and drying to enhance the sufficient pre-germinative metabolic process for rapid germination. Seed priming is a controlled hydration process followed by re-drying that allows the seed to imbibe water and begin internal biological processes necessary for germination, but which does not allow the seed to germinate (Sarkar *et al.*, 2020). Various physiological and non-physiological techniques for proving seed germination such as humidification, wetting, and presoaking (Waqas *et al.*, 2019). The other techniques for promoting germination are comprised of chemical treatments, seed inoculation with beneficial microbes, and seed coating. However, many factors affect the performance of seed priming such as plant species, priming duration, temperature, priming media, and their concentration and storage conditions. (Waqas *et al.*, 2019; Dawood, 2018). Many authors stated that seed priming helps the germination of coriander (Ayen and Cherif, 2013; Jamshidian, and Talat, 2017; Rouhi *et al*., 2018; Sarkar *et al.*, 2020). Nevertheless, Rithichai and Pipatkornsakul (2008) indicated that hydropriming can improve the germination and vigor of coriander seeds, by seeds soaking in distilled water for 8 hours and incubated at 20 ℃ for 24 hours. The cattle fecal extracted is the waste from the process of vermicomposting. It is a liquid solution that is rich in available plant nutrients. But the vermicompost owners haven't used this solution for any benefits. The hydropriming is the low-cost, quick, simplest, safest, and effective method for increasing seed germination of some vegetables (Rouhi *et al.*, 2018). The research was investigated the effects of concentrate of cattle fecal extract on the germination of coriander seeds using hydropriming technique.

Materials and methods

The study was carried out at the Faculty of Agriculture, Uttaradit Rajabhat University, Thailand. A factorial experiment using a completely randomized design (CRD) was used to study the germination of coriander. Two factors were factor A, seed priming (priming, non-priming), and factor B, the concentration of cattle fecal extraction (20, 40, 60, 80, and 100 %), distill water use as control. There were 3 replications of 2x6=12 treatments combinations. All seeds were placed onto the tissue paper which soaking in

each concentration of the cattle fecal extract. The experiment was conducted in the laboratory.

Cattle fecal extractions

The steps of vermicomposting started to prepare the bedding for earthworms by using the cattle fecal. The cattle feces were soaked with pure water (1:1, V: V) for 24 hours, and then drained until the third time. Then, the solid of cattle fecal was used as the bedding for vermicomposting. The first liquid solution from the cattle fecal extraction was filtered and used for experiment which diluted by distilled water as 20, 40, 60, 80, and 100 percent. The parameters (pH, EC, N, P, K, Ca, Mg, and S) of the first liquid solution from the cattle fecal extraction were analyzed.

Seed priming

The commercial of coriander seeds were used for the germination test. The seeds were soaked with different concentrations of fecal extract for 8 hours each. Then the seeds were stored at room temperature (28-32℃) for 72 hours and all seed treatments were germinating.

Germination tests

Three replicates of 50 seeds were tested for germination by top of the paper (TP) method in a 9 x14 x5 (WxLxH) $cm.^3$ plastic box. The tissue papers were soaked in each concentration of fecal extract treatment and placed into the bottom of the box then the seeds were put on top of soaking papers.

Measurements

Germination of the seedlings was daily recorded until day 7. The data of germination mean time (GMT), germination rate (GR), normal and abnormal, stem high, and root length of seedlings was measured.

Statistical analysis

The data of germination mean time (GMT), germination rate (GR), germination percentage, normal and abnormal seedlings, stem high, and root length were computed analysis of variances by using SPSS.

Results

The parameters of the liquid solution from the cattle fecal extraction compose of pH, EC, N, P, K, Ca, Mg, and S. The first extraction the pH =

7.7, EC= 1.96mS/cm, Total N=0.22 %, Total P=9.28 %, Total K, Ca, Mg, and S as 1,127.00, 44.80, 113.90, and 35.29 mg/L. respectively. The second, and the third extraction N, P, and K were measured. The secondary data shows 0.14%, 3.78%, and 1,016.00 mg/L for N P, and K values respectively. The third, 0.12%, 2.65%, and 883.6 mg/L for N P, and K values respectively. The results indicated that more frequently extractions decreased parameter values were found. The data show in table1.

Table 1. The chemical parameters in the solution of cattle fecal extractions

Samples	***Parameters***	***Values***	***Methods***
The first	pH	7.7 unit@25°C	pH meter
extracted solutions	EC	1.96mS/cm	Conductivity meter
	Total N	0.22 %	Kjeldahl method
	Total P	9.28 %	Digestion/UV-Vis spectrophotometer
	Total K	1,127.00	Digestion/ Atomic Absorption
	Ca	mg/L	spectrophotometer
	Mg	44.80 mg/L	
		113.90 mg/L	
	S	35.29 mg/L	Turbidimetric Method
The second	Total N	0.14 %	Kjeldahl method
extracted solutions	Total P	3.78 %	Digestion/UV-Vis spectrophotometer
	Total K	1,016.00 mg/L	Digestion/ Atomic Absorption spectrophotometer
The third	Total N	0.12 %	Kjeldahl method
extracted solutions	Total P	2.65 %	Digestion/UV-Vis spectrophotometer
	Total K	883.60 mg/L	Digestion/ Atomic Absorption spectrophotometer

The data analysis reported by Uttaradit Rajabhat University, Science Center, Thailand

The cattle fecal extractions solution affected coriander seed at a highly significant difference in mean germination time (GMT) and germination rate (GR). The coriander seeds that were primed with the cattle fecal extractions solution decreased the time for germination. On the other hand, cattle fecal extractions solution caused seed germination rate higher than seeds that were non-priming. It seems to be like seed priming with a high concentration of cattle fecal extractions solution more affected on GMT as presented in 40, 60, and 80 %. The data were shown in table 2 and 3.

Table 2. Mean comparison of seed priming on mean germination time (GMT) of coriander seeds

Seed treatment	cattle fecal extraction concentrate (%)						
	0	20	40	60	80	100	Mean
no-priming	4.46±0.16	4.30±0.34	3.97±0.34	3.73±0.12	3.84±0.32	4.65±0.98	4.16±0.52[a]
Priming	3.73±0.18	4.02±0.13	3.56±0.13	3.41±0.22	3.72±0.24	3.45±0.19	3.65±0.26[b]
Mean	4.09±0.43	4.16±0.28	3.76±0.32	3.57±0.23	3.78±0.26	4.06±0.90	
Seed treatment (A)				*			
Extraction concentrates (B)				ns			
A x B				ns			

Mean in columns followed by different letters are significantly different at P= 0.05, ns= non-significant, *= significant different at P<0.05

Table 3. Mean comparison of seed priming on germination rate (GR) of coriander seeds

Seed treatment	cattle fecal extraction concentrate (%)						
	0	20	40	60	80	100	Mean
no-priming	0.22±0.01	0.23±0.02	0.25±0.02	0.27±0.01	0.26±0.02	0.22±0.05	0.24±0.03[b]
Priming	0.27±0.01	0.25±0.01	0.28±0.01	0.29±0.02	0.27±0.02	0.29±0.02	0.27±0.02[a]
Mean	0.25±0.03[ab]	0.24±0.02[b]	0.27±0.02[ab]	0.28±0.02[a]	0.27±0.02[ab]	0.26±0.05[ab]	
Seed treatment (A)				*			
Extraction concentrates (B)				**			
A x B				ns			

Mean in columns followed by different letters are significantly different at P= 0.05, ns= non-significant, *= significant different at P<0.05, **= significant different at P<0.01

Percentage of coriander germination

The difference between primed and non-primed seeds was highly significantly different. Seed primed had a percentage of germination higher than non-primed seeds. While factor B was highly significant different, the difference of concentrate of cattle fecal extracted solutions gave the seeds germination different at days 2, 4, 5, and 6 after sowing. The interaction among seed primed, and concentration of the cattle fecal extraction had high significantly different on days 4, 5, and 6 after sowing. Rapid seed germinations were found in the seeds priming technique. For all primed treatments the seeds germinated on day 2, excepted NPW and NP20 occurred on day 3 after sowing. That means priming seeds with cattle fecal extraction increased percentage of germination and reducing the time for start to germination. The highest germination percentage on day 2 was found in P100 followed by P40, and P60 as 17.33, 16, and 14 % respectively. While the lowest was 3.66 in primed with distilled water. It had shown that P80 (the concentration of cattle fecal extraction at 80 %) had a little slight over P60 during days 5-7 after sowing. The results show clearly that two factors combination (priming seed and concentrating of

liquid solutions of cattle fecal extraction) had affected to seeds germination of coriander during days 4, 5, and 6 after germination. The seeds that were primed by a high concentration of cattle fecal extraction (P60, 80, and 100) gave a highly of seeds germinated dramatically as shown in table 4.

Table 4. Seeds germination percentage during 7 days after sowing

		day2	***day3***	***day4***	***day5***	***day6***	***day 7***
Seed treatment (A)	Non-priming	2.22±3.35 b	12.44±10.28 b	23.66±13.19 b	27.66±13.63 b	29.77±15.45 b	32.77±15.07 b
	Priming	12.11±5.15 a	41.66±11.04 a	65.66±10.61 a	73±8.81 a	75.33±8.56 a	79.44±7.12 a
Extracted concentrates (B)	Water	3.66±4.08 b	22.33±21.63	37.66±28.38	41.66±31.14	44.33±34.09	47.66±34.04
	20	4.33±5.57 b	20.33±15.57	37.66±28.38	44.66±19.66	46.00±18.54	52.66±24.15
	40	9.00±8.17 a	27.66±16.65	46.66±22.65	53..00±21.82	55.00±23.99	58.00±24.65
	60	9.33±7.55 a	35.00±23.82	52.66±28.86	57.00±29.90	59.00±28.86	60.66±30.05
	80	7.33±3.72 b	29.66±12.35	51.66±17.95	58.00±22.34	62.33±23.23	64.66±22.22
	100	9.33±8.91 a	27.33±20.92	41.66±31.55	47.66±33.16	48.66±31.94	53.00±29.81
AxB	NPW	0.00±0.00	3.33±2.30	12.00±2.00 e	13.33±1.15 e	13.33±1.15 f	16.66±3.05
	NP 20	0.00±0.00	10.00±12.49	22.00±12.49 e	28±10.58 cde	30.66±11.54 de	33.33±16.16
	NP 40	2.00±2.00	12.66±3.05	26.00±0.00 e	33.33±5.03 cd	33.33±5.03 e	36.00±7.20
	NP 60	4.66±6.43	15.33±5.03	27.33±3.05 e	30.66±5.03 cd	33.33±3.05 e	34.00±6.00
	NP 80	5.33±2.31	24.66±17.00	40.66±20.81 cd	42.66±22.74 c	48.00±26.45 cd	50.66±24.11
	NP 100	1.33±2.30	8.66±4.61	14.00±8.00 e	18.00±7.21 de	20.00±8.71 f	26.00±6.00
	PW	7.33±1.15	41.33±9.01	63.33±5.77 b	70.00±4.00 ab	75.33±4.61 b	78.66±2.30
	P 20	8.66±4.61	30.66±11.37	53.33±11.54 bc	51.33±4.61 b	61.33±4.61 c	72.00±8.71
	P 40	16.00±4.0	42.66±3.05	67.33+1.15 b	72.66±2.30 ab	76.66±2.30 b	80.00±4.00
	P 60	14.00±6.0	54.66±15.27	78.00±12.16 a	83.33±11.37 a	84.66±9.86 a	87.33±9.45
	P 80	9.33±4.16	34.66±4.16	62.66±3.05 b	73.33±5.03 ab	76.66±5.77 b	78.66±8.08
	P 100	17.33±1.15	46.00±5.29	69.33±11.37 ab	77.33±7.57 ab	77.33±3.05 b	80.00±0.00
F-test	A	**	**	**	**	**	**
	B	*	ns	*	*	*	ns
	AxB	ns	ns	*	*	*	ns

Mean in columns followed by different letters are significantly different at P= 0.05, ns= non-significant, *= significant different at P<0.05, **= significant different at P<0.01

NPW = non-priming + distil water, NP 20, 40, 60, 80, 100 = non-priming + cattle fecal extraction concentrate at 20,40,60,80, 100 % respectively, PW = priming + distil water, P20, 40, 60, 80, 100 = seed priming + cattle fecal extraction concentrate at 20, 40, 60, 80, 100 % respectively

The seedling characters

The uniform of seedlings was measured as normal, abnormal, shoots, and root length. The results show that a highly significant difference was found. The seedlings from the priming technique had the percentage of normal seedlings higher than no primed as about 2 times. The shoots and root length had significantly different. The shoots in non-priming technique had (4.15cm.) longer than the priming technique (3.90 cm.). Suppressing of the shoot length of coriander seedlings was observed in seeds primed with a high concentration of cattle fecal extraction. Whereas, the priming technique gave the root longer than non-priming. The higher root length was found in a high concentration of cattle fecal extraction as in P40 and P100. The data are shown in table 5 and 8.

Table 5. Effect of cattle fecal extraction on percentage of normal seedling

Seed treatment	cattle fecal extraction concentrate (%)						
	0	20	40	60	80	100	Mean
no-priming	12.00±2.00	24.66±15.14	28.66±5.03	28.66±9.01	35.33±17.92	18.00±6.92	24.55±12.05^{b}
Priming	59.33±5.03	50.66±10.26	56.66±4.16	68.00±17.08	56.66±4.16	66.66±3.05	59.66±9.65^{a}
Mean	35.66±26.15	37.66±18.34	42.66±15.88	48.33±24.76	46.00±16.49	42.33±27.08	
Seed treatment (A)	*						
Extraction concentrates (B)	ns						
A x B	ns						

Mean in columns followed by different letters are significantly different at P= 0.05, ns= non-significant, *= significant different at P<0.05

Table 6. Effect of cattle fecal extraction on percentage of abnormal seedling

Seed treatment	cattle fecal extraction concentrate (%)						
	0	20	40	60	80	100	Mean
no-priming	4.66±3.05	8.66±2.30	7.33±4.61	5.33±3.05	15.33±9.86	8.00±3.46	8.22±5.56^{b}
Priming	19.33±5.77	21.33±8.08	23.33±7.57	19.33±8.08	22.00±12.00	13.33±3.05	19.77±7.41^{a}
Mean	12.00±9.03	15.00±8.74	15.33±10.40	12.33±9.41	18.66±10.48	10.66±4.13	
Seed treatment (A)	*						
Extraction concentrates (B)	ns						
A x B	ns						

Mean in columns followed by different letters are significantly different at P= 0.05, ns= non-significant, *= significant different at P<0.05

Table 7. Effect of cattle fecal extraction on shoot length of seedling (cm)

Seed treatment	cattle fecal extraction concentrate (%)						
	0	20	40	60	80	100	Mean
no-priming	3.15+0.32^{d}	4.11+0.08^{bc}	4.39+0.56^{bc}	4.88+0.15^{a}	4.15+0.45^{bc}	4.24+0.28^{bc}	4.15+0.60^{a}
Priming	2.92+0.26^{d}	3.91+0.25^{c}	4.04+0.34^{c}	3.94+0.20^{c}	4.55+0.20^{ab}	4.07+0.09^{bc}	3.90+0.54^{b}
Mean	3.03+0.29	4.01+0.19	4.21+0.46	4.41+0.53	4.35+0.38	4.15+0.21	
Seed treatment (A)	*						
Extraction concentrates (B)	**						
A x B	*						

Mean in columns followed by different letters are significantly different at P= 0.05, ns= non-significant, *= significant different at P<0.05, **= significant different at P<0.01

Table 8. Effect of cattle fecal extraction on root length of seedling (cm)

Seed treatment	cattle fecal extraction concentrate (%)						
	0	20	40	60	80	100	Mean
no-priming	2.90+0.53	3.25+0.28	3.09+0.48	3.66+0.55	3.48+0.33	3.41+0.25	3.30+0.44[b]
Priming	3.63+0.29	3.38+0.38	3.98+0.13	3.55+0.43	3.91+0.22	3.24+0.30	3.61+0.37[a]
Mean	3.27+0.55	3.31+0.31	3.54+0.58	3.61+0.45	3.69+0.34	3.33+0.26	
Seed treatment (A)				*			
Extraction concentrates (B)				ns			
A x B				ns			

Mean in columns followed by different letters are significantly different at P= 0.05, Ns= non-significant, *= significant different at P<0.05

Discussion

The results of this experiment showed that coriander seeds primed with cattle fecal extraction improved the quantity and quality of germination with decreased mean germination time, a higher percentage of seed germinations, and seedling healthy than those of non-primed. The coriander seed that was primed with cattle fecal extraction had a mean germination time (3.65) lower than the non-primed seed (4.16). The seed priming starts to germinate on day 2 after sowing while non-primed seeds start to germinate on day3(NPW, NPC20). This confirms the results by Jisha *et al*. (2013) reported that hydropriming is a very important seed treatment technique for rapid seed germination and uniform seedling (Tu *et al.*, 2022). Seed priming increases seed germination and emergence uniformity, with an effect on the final germination percentage of the seed. The seed hydropriming treatment at 25℃ was the most effective for decreasing the time of germination, root growth, and seed vigor (Thornton and Powell,1992). The results of seed primed effected on seed germination and seedling health were similar to various of research. Ayen and Cherif (2013) reported that primed seeds possessed higher emergence and growth rates than control. Seed priming has been commonly used to reduce the time between seed sowing and seedling emergence and to synchronize emergence (Parera and Cantliffe, 1994). Several investigations confirmed that seed priming has many benefits including early and rapid emergence (Taylor and Harman 1990, Van Hulten *et al.*, 2006). The same results were reported by Lopez *et al.* (2016) showed that seed priming with distilled water increased germination synchrony and reduced the lag time for the start of germination. The seed primed had 2.67 times of germination percentage over non-primed on the final day. This result is similar to various research studies that have explained that hydro-priming increases germination and seedling growth by 3–4 times as compared to non-priming (Kaur *et al.*, 2002). Rouhi *et al.* (2018) reported that hydropriming significantly improved final germination percentage, germination rate, and seedling length. Yan (2016) stated that hydropriming increased germination percentage, germination potential, and vigor index. The seeds that were

primed with cattle fecal extraction caused the root length of coriander, as seen in NPW had 2.93 cm. while PC80 had 3.91 cm. in root length. Thus, seed primed enhanced root vigor. Sarkar *et al*., (2020) said that hydropriming of seeds may improve germination and emergence and may promote vigorous root growth. In addition, this research showed seeds that were primed with cattle fecal extraction (PC40, 60, 80) caused MGT, GR, percentage of germination, and normal seedling greater than distilled water. The steps of earthworm feeding for vermicomposting, for suitable feed and time saved, the cattle manure was soaked with water and then drained until the third time. While after analysis of the chemical properties in cattle fecal extraction shows that the first extraction comprised of available values for plant growth. The solution has optimum pH, and riches in the major and minor plant nutrients at a high level for the first time of extraction. The decrease in plant nutrient values occurred in more frequent extractions. Thus, leaving off the cattle fecal extraction solution is an un useful idea. Surprisingly, almost of various research also seed priming by using distilled water or other chemical treats. Whereas, this method is more affected than other methods. Thus, the cattle fecal extracted solution is the new one of priming technique for improving seed development. Because this is a local product from the farmers, It is simple, does not require special equipment, availability, cost saved, more economic, non-toxic, and environment friendly. Finally, it is very useful for farmers by using cattle fecal extraction solution as 60 % concentrate for seed priming before sowing.

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