Sri Lankan Journal of Technology
Research
SLJoT
2025 Sp.Issue 42-52
ISSN-2773-6970

Effect of Cow Urine and Coconut Water as Seed Priming on Growth and Yield of Soybean

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Received: 26-11-2024. * Accepted: 11-04-2025 * Published Online: 05-05-2025

Abstract- The study was done to find out the effect of seed priming using cow urine and coconut water on the growth and yield of soybean cv. PB-1. This experiment was designed in a completely randomized design with six treatments. They included distilled water, 3% cow urine and 3% coconut water, as seed priming media for 6- and 12-hours soaking durations. The findings exhibited that there were remarkable impacts on germination percentage, growth and yield of soybean by soaking media and durations. Further, it was noted that most of the studied traits were showed better performances in seeds soaked for 12 hours when compared to the control treatments. In this research work, the seeds soaked in 3% coconut water for 12 hours considerably enhanced the growth and yield of soybean than the other treatments. Hence, it could be concluded that yield of soybean can be increased by seed priming method using 3% coconut water as seed soaking medium for 12 hours duration.

Keywords: Soybean, priming solution, coconut water, cow urine

Dissanayaka, D. M. S. N., Seran, T. H. & Damlathge, T. H**.** (2025). Effect of cow urine and coconut water as seed priming on growth and yield of soybean. *Sri Lankan Journal of Technology*,*6*(Special Issue*)*.42–52.

1. Introduction

Soybean (*Glycine max* L.) is an important pulse crop with high nutrition and staple of human diet, especially in Asia. Whole soybeans, soybean oil, and protein products are traded on global markets (Rodrigues and Vinardell, 2006). Soybean contains approximately 8.5% of moisture, 36.5% protein, 30.2% carbohydrate, 19.2% fat, and 4.9% ash in 100 g and also consist of considerable fiber (Field Crop Research Institute, 2021). Oil seeds are sensitive to severe weather conditions. Kausar *et al*. (2009) stated that oil content quickly oxidizes and deteriorates seed health during storage (Kausar *et al*., 2009). Germination, quick emergence and good establishment of seedlings in the field are important for production and pose a significant impact on plant growth for ensuring high crop yield and superior quality in annual crops (Yari *et al*., 2010).

Seed priming enhances germination and emergence in seeds of several crops (Donaldson *et al*., 2001). By using this technique, germination rate, seedling stands and crop yield can be improved (Talebian *et al*., 2008). Advantages of seed priming in all crops comprise faster emergence, uniform vigorous seedlings, and high crop yield (Harris *et al*., 2001). Seed priming facilitates uniform germination by way of enzyme activation and improved antioxidant defense mechanisms than non-primed seed (Farooq *et al*., 2012).

Coconut water contains a variety of amino acids, vitamins, sugars and plant hormones (Shekarriz *et al*., 2014). Seed soaking in coconut water had remarkable effect on the germination percentage (Torres *et al*., 2011). Coconut water, obtained from drupe of *Cocos nucifera* has been shown to exhibit a wide range of active growth regulatory activities in plants (Yong *et al*., 2009). Coconut water had positively affected the germination and subsequent growth of Kola nuts (Undie *et al*., 2018).

There are no other seed treatment substances similar to cow urine in the world (Technical Protocol, 2021). Locally available wastes of cow dung and cow urine contain macro and micronutrients (Piraveena and Seran, 2010). Cow urine contains various compounds, including potassium, calcium, magnesium chloride, urea, phosphate, ammonia, and creatinine. Bijamirta is a seed treatment process that uses locally available substances such as cow urine and manure (Vyankatrao, 2019).

The germination and vigour index of tamarind seeds were improved by immersing them in a 10% cow urine or cow dung liquid for 24 hours (Sankanarayanan *et al*., 1994). Arif *et al*. (2008) stated that priming of soybean seeds gives better healthy seedlings and boosts crop yield. Hence, this study was planned to evaluate the effect of seed priming using cow urine and coconut water on growth and yield of soybean.

2. Materials and Methods

The study was done at home garden in Ettampitiya, Badulla district, Sri Lanka (6º56′19.32″ºN latitude and 30º59′18.13″ºE longitude). The site falls within the intermediate zone with annual mean values of 20 C^{o} - 23 C^{o} temperature and rainfall of 2000 mm. The soybean variety PB-01 was used for the study which is an erect type grown up to 50-60 cm with 80-85 days taken for harvesting after seeding.

It was adopted a complete randomized design with six treatments and five replicates. Spacing was row 40 cm apart and 10 cm within the row. The seeds of the soybean were obtained from the Department of Agriculture, Ampara. Cow urine and cow dung were collected from a house in the village. Then 3% solution of cow urine or coconut water were prepared using distilled water. Thereafter, soybean seeds were immersed in prepared solutions or distilled water (control) for 6 and 12 hours as indicated in Table 1.

Table 1
Treatments used in this experiment.

Treatment code	Description	
	Soaking solution	Soaking time (hr)
T1	Distilled water	6
T2	Distilled water	12
T3	Cow urine (3%)	6
T4	Cow urine (3%)	12
T5	Coconut water (3%)	6
T6	Coconut water (3%)	12

Treated soybean seeds were sown in polybags (35 × 22 cm) filled with soil and cow dung. Three seeds were placed in a bag (2 cm depth) and irrigated 2-day intervals until germination.

Germination count was recorded every day when the radical emerged up to 2 mm. In addition, plant height, leaf number and internode number for each plant were recorded at 2nd and 4th weeks after planting. Flower and pod numbers per plant were counted at every week until harvest. Picking was done for three times per week and number of pods, pod length and also air-dry pod weight and seed weights per plant were taken after harvesting pods. Further, 100 seed weight was taken after harvesting. Total seed yield was calculated.

The collected data was analyzed using Statistical Analysis Software (SAS 9.1 version) and subsequently treatment comparison was done using Tukey's test at 5% significant level.

3. Results and Discussion

Germination percentage

According to the Figure 1, seeds started germination on 3 days after of seed sowing irrespective to the treatment. However, during 4-7 days after sowing, the lowest germination percentages were recorded by T1 where seeds were soaked in distilled water for 6 hours soaking duration (control treatment). Higher germination percentage (86.7%) was noted in T3 (cow urine for 6 hours soaking) than T1 treatment (control) but lesser than coconut water treatment.

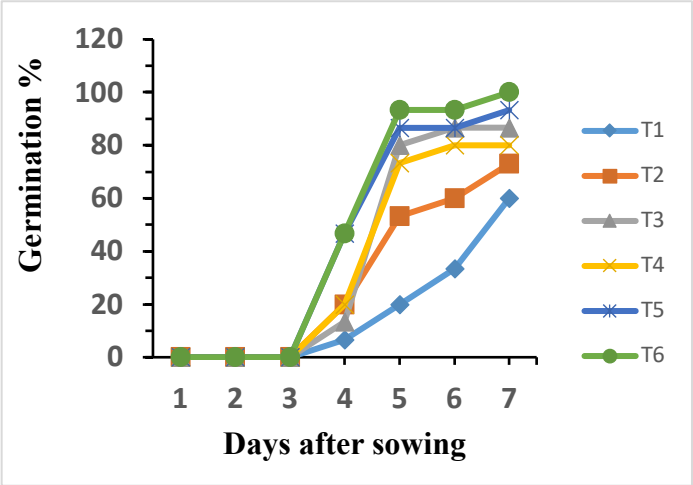

Figure 1. *The daily germination of seeds in each treatment during 1st-7th days after seed sowing.*

The effect of seed priming on final germination percentage on 7th day after seed sowing is presented in Table 2. The germination percentage was remarkable ($P<0.001$) influenced by seed priming media and durations. The germination percentage (100%) was high in 12 hours of seed priming with coconut water (T6), which was remarkably different from the control treatments (T1 and T2). The lowest germination (60%) was noted in control.

The priming durations did not significantly affect germination percentage of seeds soaked with cow urine or coconut water treatment. The findings of Shekarriz *et al*. (2014) alligned with our results as they found that coconut water increased the germination percentage of Hybrid *Phalaenopsis* and *Cymbidium findlaysonianum.* Furthermore, Nurtjahja (2021) reported that coconut water was able to increase the germination percentage and plumule growth in Mung beans. It may be due to a range of biochemical changes in the seed for initiating germination process (Ajouri *et al*., 2004).

Plant height

The different priming media and durations have a substantial ($P<0.001$) effect on plant height at 2nd and 4th weeks (Table 3). The highest height was recorded in T6 (14.20 cm) and the lowest height was noted in T1 (10.44 cm) at 2nd week. In 4th week, the highly significant variation ($P<0.001$) was also noted among the treatments and height ranged from 17.34 to 23.96 cm. T3 treatment exhibited the highest plant height (23.96 cm) than the other treatments. Jandaik *et al.* (2015) showed that treating *Trigonella foenum-graecum* and *Abelmoschus esculentus* seeds with cow urine has increased the plant height. Archana and Seran (2023) experimented that when cow urine was incorporated as soil application for shallot (*Allium ascalonicum* L.), it increased plant height. This is because that cow urine consists of iron, urea and uric acid which change the inhibitory reaction for seed germination and seedling vigour (Dilrukshi and Perera, 2009).

Number of leaves

The impact of seed priming media and duration on the leaf number in a plant is shown in Figure 2 and insignificant difference was noted between the treatments. The highest average leaf number per plant (4.8 leaves) was achieved in the distilled water for 12 hours priming duration.

Leaves are important plant parts that are needed for photosynthesis. In general, increment in the leaf number in plant causes the high productivity of plant.

Number of internodes

The number of internodes in a soybean plant at 2nd and 4th weeks after seeding is given in Table 4. The different priming media and priming durations have a significant (P<0.05) effect on the internode number per plant of soybean at the 2nd week. The number of internodes was high in T5 and T6 compared with the other treatments at the 2nd week. Souza *et al.* (2013) mentioned that using of coconut water increased the number of internodes in *in vitro* cultured olive plants. In addition. Romah and Taratima (2022) stated that in coconut water, amino acids, several vitamins, sugars, cytokinins and minerals are available for promoting plant growth including the number of internodes.

Table 2

Impact of seed priming method on seed germination percentage of soybean at 7th day after seeding.

Treatments		Treatment codes	Seed germination % at 7 days after sowing
Soaking solution	Soaking duration		
Distilled water	6	T1	60.0c
Distilled water	12	T2	73.3bc
Cow urine	6	T3	86.7ab
Cow urine	12	T4	80.0abc
Coconut water	6	T5	93.3ab
Coconut water	12	T6	100.0a
F test			P<0.001

Means followed by the same letter in each column are not remarkably different according to Tukey's HDS test at P=0.05.

Table 3

Effect of seed priming technique on plant height at 2nd and 4th weeks after seeding.

	Plant height (cm)	
Treatments	2nd week	4th week
T1	10.44 d	20.48ab
T2	11.72c	23.20a
T3	12.94b	23.96a
T4	12.08bc	17.34b
T5	12.90b	23.04a
T6	14.20a	20.98ab
F test	P<0.001	P<0.001

Means followed by the same letter in each column are not considerably different according to Tukey's HDS test at P=0.05.

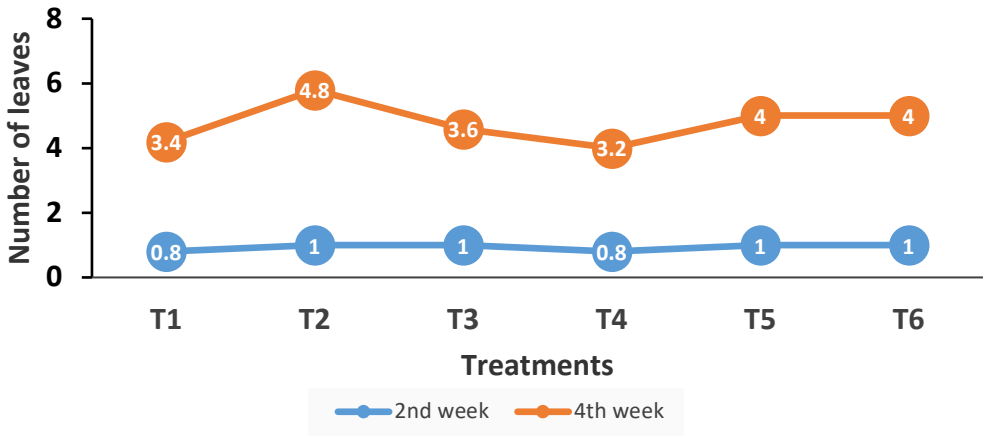

Figure 2. *The number of leaves per plant at 2nd and 4th weeks as influenced by seed priming.*

Table 4

Impact of seed priming technique on number of internodes in a plant at 2nd and 4th weeks and number of flowers in a plant at 5th week after seeding.

Treatments	Number of internodes per plant		Number of flowers per plant at 5th week after sowing
	2nd week	4th week	
T1	0.6b	2.8	1.6b
T2	1.2ab	3.8	2.6ab
T3	1.4ab	3.4	3.0ab
T4	1.0ab	2.6	3.0ab
T5	1.6a	4.0	4.6a
T6	1.6a	3.8	5.2a
F test	P<0.05	P>0.05	P<0.01

Means followed by the same letter in each column are not significantly different according to Tukey's HDS test at P=0.05.

Number of flowers

Table 4 demonstrates the effects of seed priming method on the number of flower formations per soybean plant at the 5th week after seeding. T6 showed the highest number of flowers (5.2) and T1 and T2 (control) treatments showed a lowest flower number than the other treatments. Similar results reported by Deshi *et al.* (2021) that coconut water has increased flower bud formation, thus, increased the number of flowers in potatoes. In addition, Srikanth and Chaurasia (2021) investigated that treating the seeds with coconut water for a longer duration increased the flowering attributes of chickpea.

Number of pod formation

The result obtained on the number of pod formations per plant of soybean showed that there were no statical variations between the treatments at 6th, 7th and 8th after seeding (Figure 3). In general, highest pod formation was noted in T6 (23.8) and the lowest pod formation in a plant was showed in T1 (19.4) at the 8th week after sowing. These results were proved by the findings of Sankar (2020) who discovered that using of coconut water has increased the pod formation in green gram. Supporting above results, Varun *et al.* (2022) studied that lentil (*Lens culinaris* M.) gave high pod number in a plant when its seeds were immersed in coconut water.

Number of harvested pods

A significant (P<0.001) difference was observed in the number of mature pods in a plant of soybean at harvest (Table 5). The highest pod formation was obtained in T6 (28.2) and the lowest result was attained in the control treatments (22.4). In addition, a remarkable variation in number of pods was noted between T5 and T6 treatments as influenced by soaking time coconut water. This result can be justified by the findings of Srikanth and Chaurasia (2021) who stated that coconut water enhanced the number of harvested pods from a plant in chickpea. Furthermore, Okti *et al.* (2024) found out that treating the seeds with coconut water increased the pod yield of Peanut.

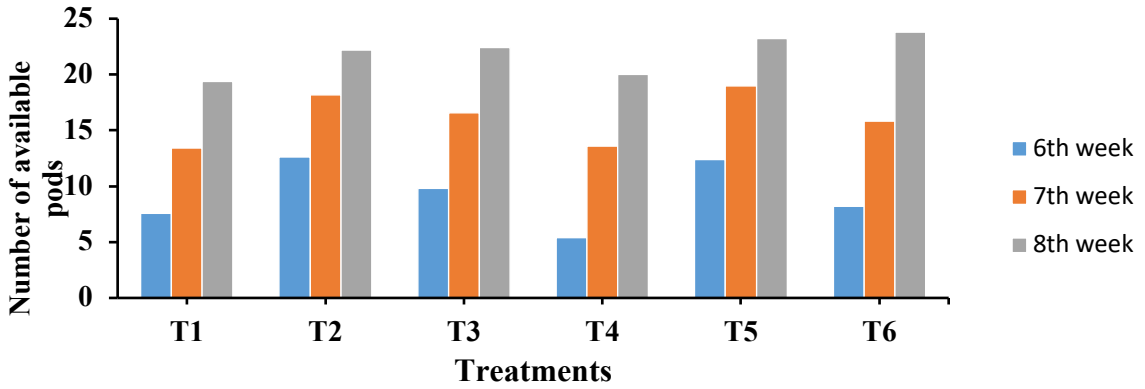

Figure 3. *Effect of seed priming on number of available pods per plant at 6th to 8th weeks after seeding.*

Table 5

Effect of seed priming method on number of harvested pods from a plant, length of single pod and weight of pods from a soybean plant at harvest (11th week after seeding).

Treatments	Number of harvested pods per plant	Length of single pod (cm)	Weight of pods per plant (g)
T1	22.4 ± 0.8b	3.92 ± 0.0	7.93 ± 0.63ab
T2	22.4 ± 0.8b	3.88 ± 0.1	7.56 ± 0.37b
T3	22.6 ± 0.5b	4.00 ± 0.0	8.18 ± 0.64ab
T4	24.2 ± 0.6b	4.04 ± 0.1	8.84 ± 0.43ab
T5	24.2 ± 0.5b	3.96 ± 0.0	8.68 ± 0.46ab
T6	28.2 ± 0.9a	4.12 ± 0.1	10.28 ± 0.46a
F test	P<0.001	P>0.05	P<0.05

Means followed by the same letter in each column are not remarkably different according to Tukey's HDS test at P=0.05.

Length of single pod

No any considerable difference (P>0.05) was observed in pod length among treatments (Table 5). The mean values were between 3.88 cm to 4.12 cm at harvest after seeding. The more pod length (4.12 cm) was recorded in T6 which was treated with a 3% concentration of coconut water and pod length (3.88 cm) was minimum in T2 (control treatment). Lakmali and Seran (2022) highlighted that the length of pods has been significantly increased by priming the okra seeds with coconut water.

Weight of pods

Airdried pod weight is the most important yield contributing character for all the plant species. Table 5 represents the impact of priming duration on the airdry weight of pods per plant at the harvest (11^{th} week after sowing). Seeds treated with cow urine and coconut water showed higher air-dry weight of pods in a plant than control treatments. The mean pod weight per plant ranged from the lowest value of 7.56 g (T2) to maximum value of 10.28 g (T6). Soeparjono (2023) revealed that red chili gave the highest number of weight of pods when its seeds were treated with coconut water. Our claim can be further supported by the following justifications; coconut water is capable of increasing the pod weight of okra (Lakmali and Seran, 2022) and peanut (Okti *et al.,* 2024).

Weight of 100 seeds

The impact of seed priming on the 100 seed weight of soybean for the different soaking periods is given in Table 6. Any considerable difference was not noted in 100 seed weight among treatments. According to the mean values, the high value for 100 seed weight was attained in T6 (11.20 g) and the minimum value for 100 seed weight was recorded in T1 (10.40 g). Ansar (2022) discovered that seeds which were treated with coconut water for long duration increased the 100 seed weight of shallots.

Seed weight

Seeds are an important part of the soybean plant which is used for consumption. The seed priming method significantly affected ($P<0.05$) the airdry weight of seeds per plant (Table 6). Highest weight of airdried seeds was noted in seeds that were primed with 3% coconut water for 12 hours of priming duration (T6) and the control treatments (T1 and T2) showed lowest. The findings of Sankar *et al*. (2020) proved that use of coconut water increased the seed weight of green gram.

Table 6

Impact of seed priming technique on 100 seed weight, seed weight and seed yield of soybean at harvest.

Treatments	100 seeds weight (g)	Seed weight per plant (g)	Seed yield (kg/ha)
T1	10.40 ± 0.22	6.69 ± 0.53ab	1673.5 ± 133.1ab
T2	10.60 ± 0.22	6.28 ± 0.30b	1569.0 ± 74.3b
T3	10.54 ± 0.22	6.96 ± 0.56ab	1740.0 ± 140.1ab
T4	10.80 ± 0.33	7.54 ± 0.35ab	1884.5 ± 88.5ab
T5	11.00 ± 0.28	7.33 ± 0.40ab	1833.0 ± 99.4ab
T6	11.20 ± 0.33	8.71 ± 0.40a	2178.5 ± 100.02a
F test	P>0.05	P<0.05	P<0.05

Means followed by the same letter in each column are not considerably different according to Tukey's HDS test at P=0.05.

Seed yield

Seed priming remarkably affected ($P<0.05$) seed yield (Table 6). Highest yield was gained in T6 (2178.5 kg/ha) and the minimum yield was recorded from T2 treatment (1569.0 kg/ha). Therefore, it is clear that there was a considerable increment of seed yield with the seed priming with coconut water at the rate of 3% concentration for 12 hours priming duration compared to

T1 and T2 (control treatments). Findings are in accordance with Lakmali and Seran (2022) as it was found that using coconut water as a priming agent has increased the seed number in a pod and seed weight of okra. Seed yields of both cow urine and coconut water for 12 hours soaking treatments (T4 and T6) were higher than those for 6 hours priming duration treatments (T3 and T5). It is clearly showed in Figure 4. The increased seed yield of 12 hours primed seeds might may be because of early emergence of seedlings in that treatment. Similar statement was reported by Sharma *et al*. (1993) who obtained higher yield to early floral initiation and more pods per plant in salicylic acid treated seeds.

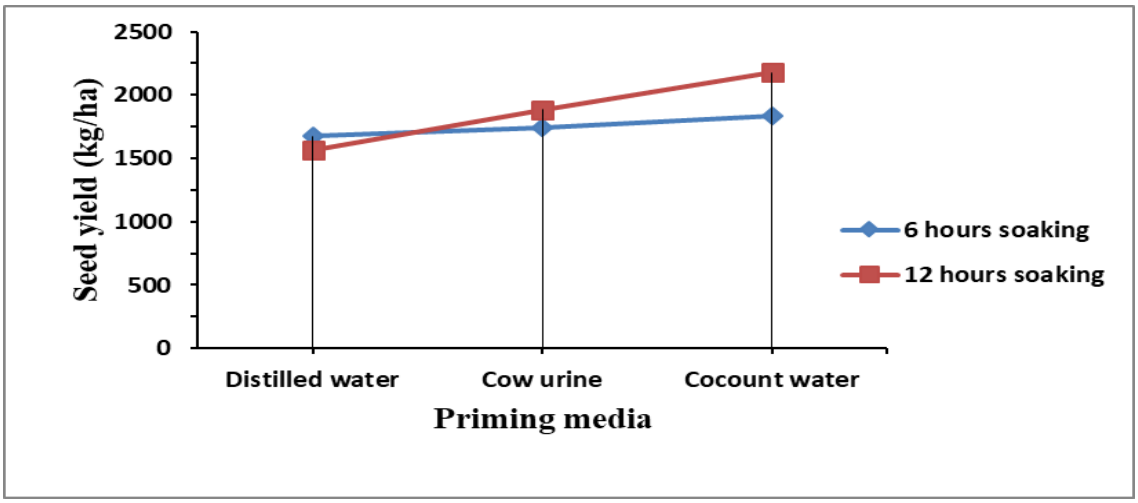

Figure 4. *Impact of seed priming technique on overall seed yield of soybean at harvest.*

4. Conclusion

Present study concluded that seed priming using cow urine and coconut water considerably ($P<0.05$) increased the growth and yield of soybean than the control treatments. The seeds treated with 3% coconut water for 12 hours increased the seed germination percentage, plant height, internode and flower numbers, number of pods at harvest, air dry weight of pods, air dry weight of seeds per plant and total seed yield. The number of leaves per plant, number of pods available per plant at 6^{th}-8^{th} weeks, length of a single pod and 100 seeds weight did not show significant differences by seed priming. Among the treatments, coconut water at the rate of 3% concentration and 12 hours priming duration gave the highest values in many measured parameters compared to the other treatments. Therefore, seed priming with 3% coconut water for 12 hours soaking time could be recommended to increase the seed germination and crop productivity of *Glycine max* (L.).

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