

RESEARCH PAPER

Allelopathic Assessment by Interaction Effect of Coconut Water (*Cocos nucifera* L.), and Dipping Time on Seed Germination of Four Cereal Seeds.

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ABSTRACT:

Coconut water (*Cocos nucifera* L.) is a biological and sterile liquid from coconut kernel. It contains a variety of ionic materials, sugars, amino acids, and several plant growth regulators. This work has been achieved in plant physiology research laboratory in Biology Department, College of Science at Salahaddin University/Erbil during July to December 2019. The purpose of this study is to evaluate the effect of concentration, different dipping time and the interaction between both seed germination and seedling radicle and plumule length. The effect of different concentrations (1%, 2%, 3%, and 4% v/v) of coconut water and different dipping times (5, 10, 15, and 20 seconds) on four cereal seeds germination and seedling parameters, the seedling plumule and radicle lengths, also the interaction between both treatments were studied. In this study it claims that when using different concentrations, the best one is the 3% concentration that effects on percent germination of all seeds used in this study, where the higher germination percentage was recorded. The best effective concentration on radicle and plumule elongation was in 1% and all concentrations showed significant effect. The best active dipping time was at 5 seconds and others also showed significant effect on both radicles and plumules. In the case of interaction of both treatments the more positive effective interaction was at 5 seconds in 4% concentration on radicles and plumules.

KEY WORDS: allelopathy, barley, sorghum, soft wheat, hard wheat, coconut water, dipping time.

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1.INTRODUCTION

The term allelopathy derived from the Greek compounds *allelo-* and *-pathos* (meaning “mutual harm” or “suffering”), was first introduced by Austrian professor Hans Molisch in 1937 in the book *Der Einfluss einer Pflanze auf die andere - Allelopathie* (The Effect of Plants on Each Other) published in German. In 1971, Whittaker and Feeny published a study where they outlined allelochemicals as all chemical exchanges among organisms (Willis, 2007).

Rice (1984) expanded the definition to include all direct positive or negative influences of a plant on another plant or on micro-organisms by the release of biochemicals into the natural environment in his monograph on allelopathy. In more recent times, Botanists started to shift back to the previous definition of substances that are produced by one plant that inhibit another plant (Willis, 2007).

Coconut water (*Cocos nucifera* L.) is a biological and sterile liquid from coconut kernel. It contains a variety of ionic materials, sugars, amino acids, and several plant growth regulators. Coconut

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water (*Cocos nucifera*) must not be mistaken with coconut milk, although some studies have used the two terms interchangeably (Kobayashi, *et al.*, 1997; Sandhya and Rajamohan, 2008). Coconut water is the aqueous part of the coconut endosperm, while coconut milk is the liquid products acquired by grating the solid endosperm, with or without the addition of water (APCC, 1994). Unlike coconut water, coconut milk, is the source of coconut oil and generally is not used in plant tissue culture medium formulations (George and Sherrington, 1984; Seow and Gwee, 1997).

Coconut water is broadly used in the plant tissue culture industry. The wide-ranging use of coconut water as a growth-enhancing component in tissue culture medium formulation can be traced back to more than 50 years ago, when first presented coconut water as a new element of the nutrient medium for callus cultures in 1941 by Van Overbeek and coworkers (Arditti, 2008). Furthermore, its nutritional role, coconut water also seems to have growth regulatory properties activity (George and Sherrington, 1984). Some of the most important and beneficial components in coconut water are cytokinins, which are a class of phytohormones (Kende and Zeevaart, 1997). In addition to many different plant-related functions, it was also discovered that some cytokinins (e.g., kinetin and *trans*-zeatin) demonstrated significant anti-thrombotic, anti-ageing, and anti-carcinogenic effects (Vermeulen *et al.*, 2002; and Rattan and Clark, 1994). Other elements found in coconut water include sugar alcohols, sugars, nitrogenous compounds, lipids, amino acids, organic acids and enzymes, and they play various functional roles in plant and human

systems because of their distinct chemical properties (George and Sherrington, 1984; Santos *et al.*, 1996; and USDA, 2009).

Inversely, coconut water is a rich addition that naturally contains plant growth regulators such as indole 3-acetic acid (IAA). The objective work of this research was to assess the capacity of coconut water extracts containing natural IAA, on adventitious radicle development in vegetative propagation of ornamental plant canes. Five different concentrations of coconut water extracts were tested. The IAA of coconut water extract recorded the best radicle development and induction. It was discovered that the radicle expression was faster (5 weeks) using the novel method. In the standard method, the canes were disseminated by quick dip application of a commercial product containing artificial hormone IAA. It takes up to 6 weeks for the canes to develop adventitious radicles to the desired level. The study shows that adventitious plumule development, radicle development, and leaf emergence of the ornamental plant was supported by IAA of coconut water extracts (Agampodi and Jayawardena, 2009). In a study where IAA and coconut water used in different concentrations and their combination on the germination of seeds. The study revealed that the combinations of coconut water and IAA were able to hasten radicles emergence, plumule height growth and increase the number of radicles for the plant *Tribulus* (*Tribulus terrestris* L.), (Akhiriana *et al.*, 2019).

Another study assessed if coconut water can be used as radicle setting medium in mangrove propagation *Rhizophora stylosa* in terms of number of radicles and average length of radicles generated. The results demonstrated that

coconut water can be used as radicle setting hormone and can be used as alternative radicle setting medium in *Rhizopora stylosa* propagation (Ogatis, 2015).

Barley (*Hordeum vulgare* L.) wheat, both soft (*Triticum aestivum* L. cv. Adana) and hard (*T. durum* L. cv. Smito), and sorghum (*Sorghum bicolor* L.) are members of the grass family (Poaceae). They are a self-pollinating. They are important cereal crops in the world. They are of the earliest domesticated crops since the start of civilization (Dhillon *et al.*, 2006).

The purpose of this study is to evaluate the effect of concentration, different dipping time and the combination of both, on seed germination percentage and seedling radicle and plumule length.

Material and Methods

This work has been achieved in plant physiology research laboratory in Biology Department, College of Science at Salahaddin University/Erbil during July to December 2019. Healthy coconut fruit (*Cocos nucifera* L.) used in this study was collected from market, Coconut water has been gotten from one fruit and kept in the refrigerator in dark bottle to be used later. Fresh white barley seeds (*Hordeum vulgare* L.), wheat seeds (*Triticum sp.*) both soft wheat (*T. aestivum* L. cv Adana) and hard wheat (*T. durum* L. cv Smito) were gotten from the agricultural research center in Kirkuk province. Sorghum seeds (*Sorghum bicolor* L.) were gotten from market. Twenty seeds, surface sterilized by rinsing for 5 seconds with 0.1% sodium hypochlorite solution, then rinsed in distilled water for each plant, prepared to be put in each of sterilized glass Petri

dishes lined with 90 mm sterilized filter paper for all experiments with four Petri-dishes for each treatment as duplicates. The following experiments were conducted for this study.

Effect of dipping time on seed germination and seedlings.

Using different dipping times for each plant seeds, for short time, lasted for 5, 10, 15, and 20 seconds in fresh concentrated coconut water, rinsed with distilled water then seeds, for each plant, were placed in marked Petri dishes and 10 ml of sterilized distilled water was added to each Petri dish. Petri dishes stoppered with para-film to prevent evaporation and placed in cold incubator at 23°C for 7 days. After which measurements of percent seed germination and the length of both plumule and radicle lengths, in millimeters, for each seedling was taken and recorded.

$$\% \text{ seed germination} = \frac{\text{germinated seeds}}{\text{sawn seeds}} * 100$$

Effect of coconut water concentrations on seed germination and seedlings.

Using 10 ml of each 1%, 2%, 3%, and 4% concentrations (v/v) of coconut water diluted solutions and were added to 20 seed containing Petri-dishes, then stoppered with para-film to prevent evaporation and placed in cold incubator at 23°C for 7 days. After which measurements of percent seed germination and the length of both plumules and radicles, in millimeters, for each seedling was taken and recorded.

Interaction effect between dipping time and different concentration on seed germination and seedling.

Here the experiment used to detect effect of the interaction of both factors on seed germination was executed by rinsing of barley, sorghum, and Wheat seeds with different times (5, 10, 15, and 20 seconds) in different coconut water concentrations (1%, 2%, 3%, and 4% v/v concentrations) and then placed in filter paper-lined Petri dishes, then adding 10 ml of distilled water, stoppered with para-film to prevent evaporation and placed in a cold incubator at 23°C for 7 days. After which measurements of percent seed germination and the length of both plumules and radicles, in millimeters, for each seedling was taken and recorded.

Controls prepared by using sterilized Petri dishes lined with sterilized filter papers and 20 surface sterilized seeds for each were sown in four replicates and 10 ml sterilized distilled water was added to be used as control instead of coconut water concentrations, stoppered with para-film to prevent evaporation and placed in cold incubator at 23°C for 7 days. After germination of seeds radicle and plumule length were measured for germinated seeds. The statistical design was *Completely Randomized Factorial Design*, and using Dunckan test to show differences between means at 0.05.

Results

The effect of coconut water on seed germination

Seed germination percent of all seeds were affected whether positively or negatively by both dipping time and different concentrations of coconut water so do the interaction of both treatments.

Results showed that the percent germination of adana wheat was affected positively in different concentration of

coconut water (1,2, and 3 %) while when it is deals with dipping time and interaction between both effects were slightly positive and negatively effects on seed germination percent, this is shown obviously in figure (1).

The Smito hard wheat was affected positively in 1% of coconut water concentration but there was fluctuation of slightly positive and negative effects on seed germination percent when it is dealing with other concentrations, dipping time and the interaction between them. These conclusions are obvious in figure (2).

The effect of different coconut water treatments on seed percent germination of white barley is same as the effects on Smito hard wheat seeds in that the most seed germination percent was at 1% concentration of coconut water, and this is quite obvious in figure (3).

Sorghum seeds Showed a very obvious sensitivity to coconut water treatments in all treatments whether concentration, dipping time, and their interactions. All treatments showed positive effects on seed germination with a smooth fluctuation from lower treatments to higher one. These are noticed when looking at figure (4). Where it has effects on nineteen treatments out twenty-eight with percentage between 96% up to 100% germination.

The effect of coconut water different concentrations, dipping time, and their interaction on seedling radicle length.

From the table (1) which shows the effect of coconut water different concentrations on radicles of cereals seedlings. It is easy to conclude that adana soft wheat seedlings radicles were significantly longer than control at concentrations of 1% and 3% and the other two (2% and 4%) concentrations were non-

significantly shorter than control mean. While Smito hard wheat seedlings radicles were significantly elongated at 1% and 2% concentrations but the other two (3% and 4%) concentrations were non-significantly shortened. All white barley seedlings radicle means were significant longer than control seedlings radicles mean. Lastly for sorghum seedlings radicle except for the radicles at concentration 1% were shorter than control mean non-significant, all other concentrations were shortened significantly.

In the table (2) which deals with effect on different dipping times of seeds in coconut water. The table shows that Adana soft wheat radicles were significantly elongated than control at times of 5, 10, and 20 seconds while at 15 seconds was elongated non-significantly. All radicles length of Smito hard wheat were significantly longer than control radicles. The same thing happened with white barley radicles in that all dipping times affected positively on radicles length in comparison with control radicles. In sorghum seeds all dipping times, except for 15 seconds, affected positively on radicles length.

The effect of the interaction of both treatments, time and concentrations, of coconut water on the radicles length of the germinated seeds tested shown in table (3) below. The Adana soft wheat seedlings radicles length all were elongated significantly except for two, 10sec. at 1% concentration and 5sec. at 2% concentration, which were shortened non-significantly. Smito hard wheat seedlings radicles, all radicles length was significantly longer than control this means that all interactions were positively effective on radicle length. All radicles length of seedlings of white barley were positively affected with different

interactions of both treatments significantly and radicles length were longer than control seedlings radicles length. But in case of sorghum seedlings radicles in all treatments were affected negatively and significantly comparing with control seedlings radicles length that means they were shorter.

The effect of coconut water different concentrations, dipping time, and their interaction on seedling plumule length.

Plumules of germinated plants shows different affect to different processing of coconut water. In table (4) different concentrations of coconut water it shows that the Adana soft wheat seedlings plumules were elongated significantly 1% concentration and decreases length significantly at concentrations 2% and 4%. The plumules of Smito hard wheat seedlings were elongated significantly at 1% and 2% concentrations. White barley seedling plumules were elongated at all concentration significantly. All concentrations of coconut water were effective positively on sorghum seedling plumules which were longer than control.

Effect of different dipping times on seedling plumules for tested cereal seeds are shown in table (5). The results show that the Adana soft wheat seedling plumules has been shortened significantly at 20 seconds dipping time and significantly elongated at 10 seconds dipping time. But the other two timings were affected non-significantly when compared with the mean of control plumule length. Seedling plumules of smito hard wheat show different responses to dipping time in that all means were significantly elongated in comparison to control seedling plumule mean. All means of white barley seedling plumules were positively affected to different dipping

times in comparison with control mean plumule length. The last plant in this treatment is sorghum where its seedling plumules were significantly shorter than the mean of control plumule except at 10seconds dipping time where the mean was bigger than control length means but non-significantly.

The effect of the interaction of both treatments, dipping time and concentrations, on plumules length of seedlings differs among tested seeds. The adana soft wheat seedling plumules were divided into two parts where half of means were elongated significantly in compare with control mean, while the other half shortened or elongated non-significantly as it is obvious in table (6) below. All Smito soft wheat plumule seedlings showed

positive significant differences with control mean and plumules were longer than control plumules. In white barley all means were positively significant and plumules were longer than that of control, except for the treatment with 20 seconds dipping at 1% concentration where its length was non-significant. The sorghum seedlings were divided into two groups, half were significantly shorter than the mean of control and the other half were significantly longer except for the treatment 15second dipping at 2% concentration which was non-significantly shortened.

Note that in all treatments means within a column followed with the same letters are not significantly differ from each other according to Duncan multiple range test at 5% level.

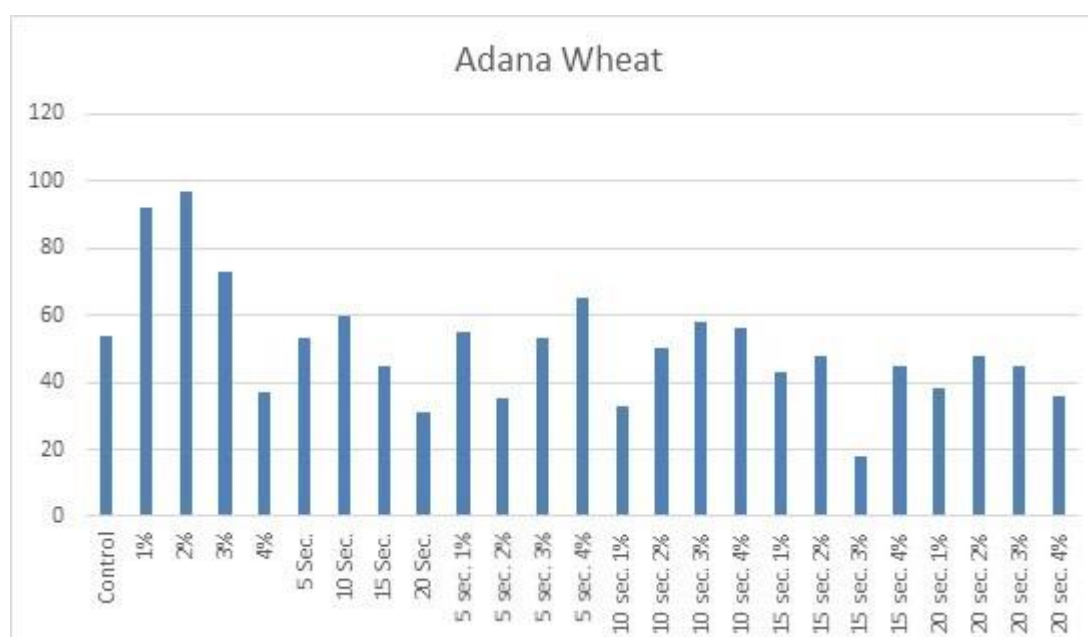


Figure 1: Effect of different treatments on Adana soft wheat seed germination percent.

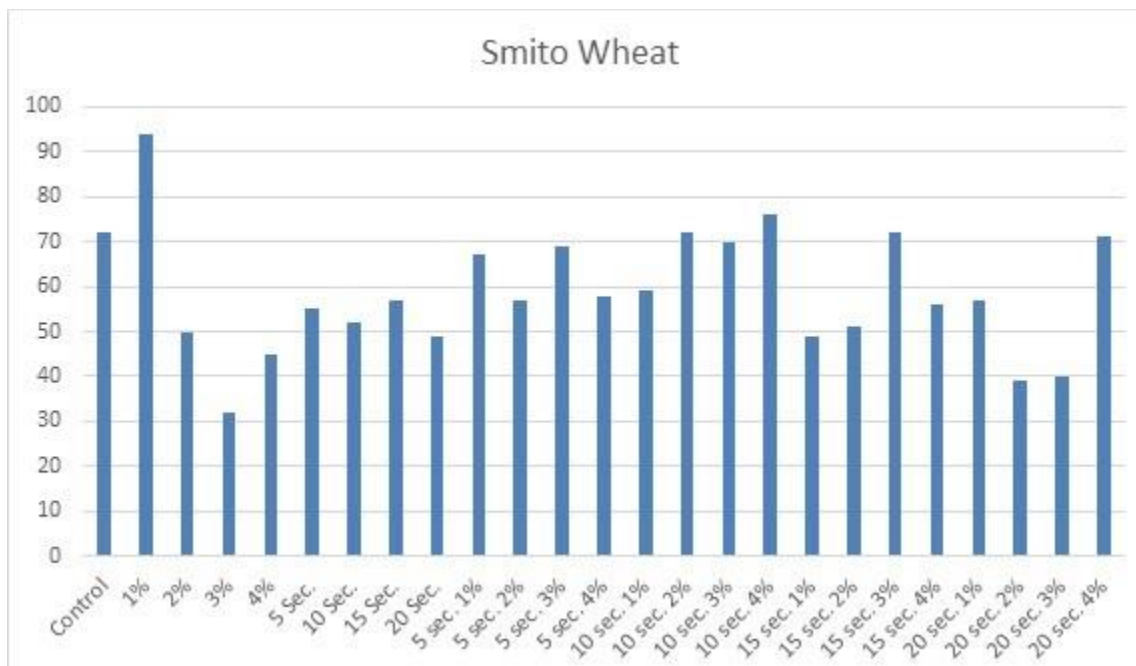


Figure 2: Effect of different treatments on Smito hard wheat seed germination percent.

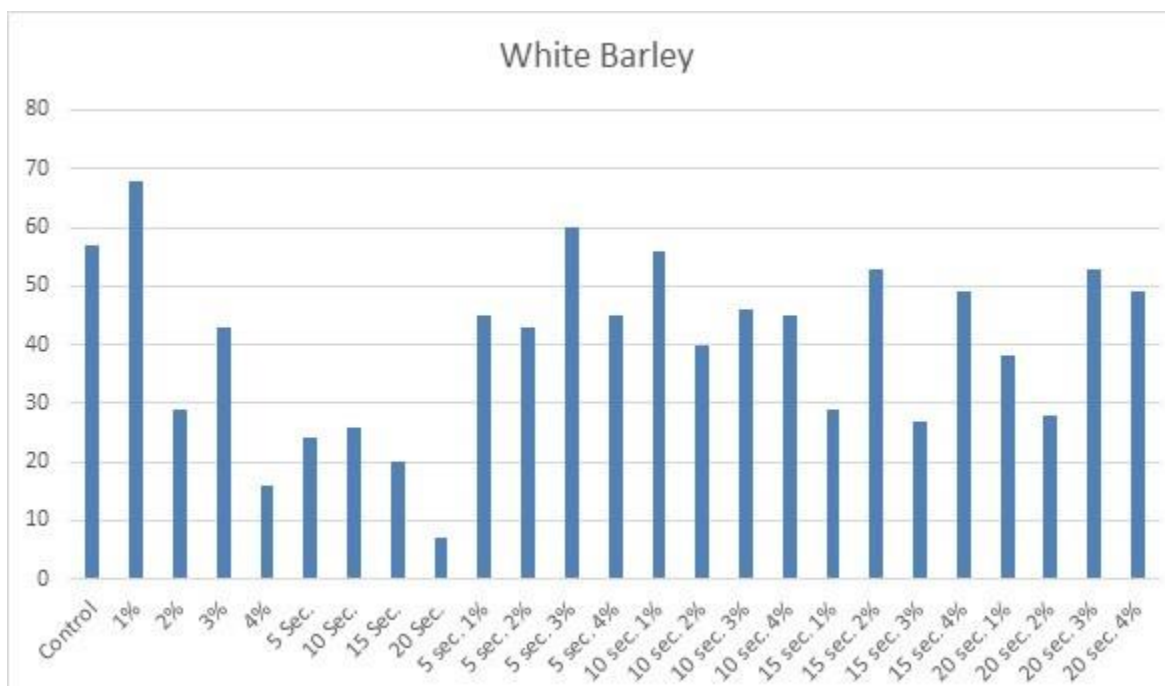


Figure 3: Effect of different treatments on white barley seed germination percent.

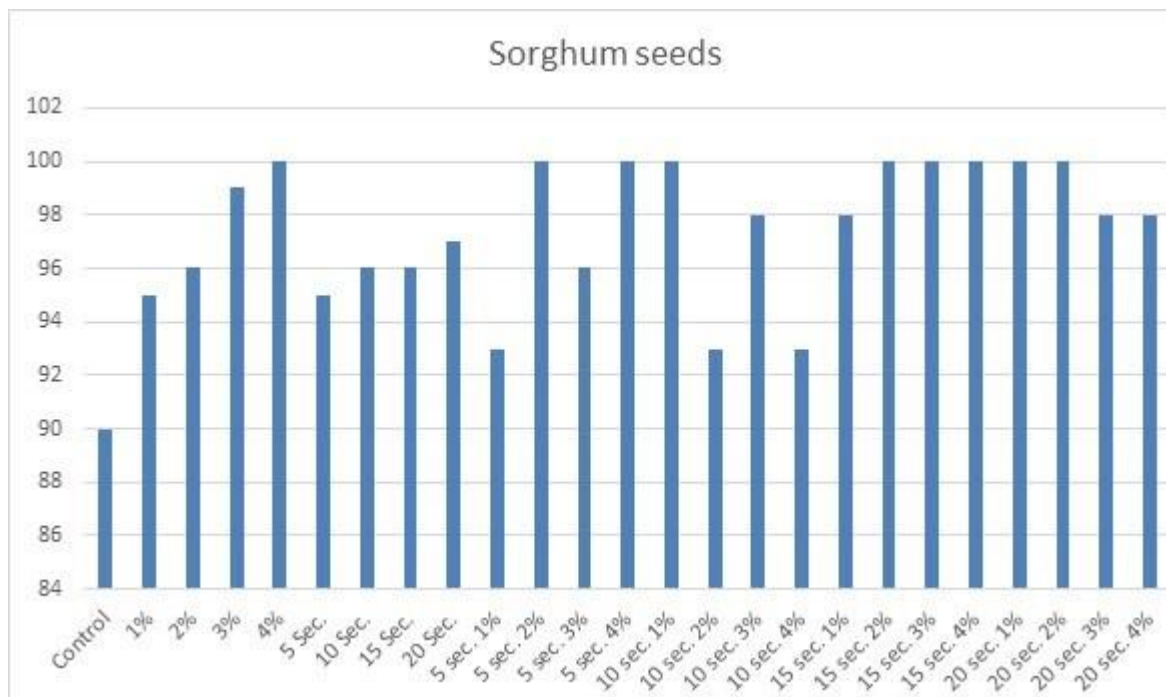


Figure 4: Effect of different treatments on sorghum seed germination percent.

Table (1) Effect of different concentrations of coconut water on radicle length of the four cereals tested seedlings.

Treatment	Adana Wheat N=22		Smito Wheat N= 37		White Barley N= 35		Sorghum N= 42	
	Radicle length (mm)		Radicle length (mm)		Radicle length (mm)		Radicle length (mm)	
	Mean	S. D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Control	10.8 ^a	7.2	27.9 ^a	15.1	33.3 ^a	9.8	126.0 ^c	183.1
1%	68.5 ^c	15.6	76.4 ^c	32.2	80.6 ^d	13.9	91.8 ^c	19.8
2%	9.9 ^a	10	46.5 ^b	20.4	83.7 ^d	20.1	82.3 ^b	27.8
3%	24.4 ^b	11.7	24.9 ^a	14.6	42.7 ^b	15.6	83.9 ^b	37.3
4%	8.5 ^a	5	20.8 ^a	8.3	56.9 ^c	31.8	37.6 ^a	23.5
Total	24.4	25.1	39.3	28.4	59.4	28	84.3	89.4

S.D. = Standard Deviation

Table (2) Effect of different dipping times in coconut water on radicle length of the four cereals tested seedlings.

Treatment	Adana Wheat N=22		Smito Wheat N= 37		White Barley N= 35		Sorghum N= 42	
	Radicle length (mm)		Radicle length (mm)		Radicle length (mm)		Radicle length (mm)	
	Mean	S. D.	Mean	S.D.	Mean	S. D.	Mean	S. D.

Control	10.8 ^a	7.2	27.9 ^a	15.1	33.3 ^a	9.8	126.0 ^b	183.1
5 Sec.	47.6 ^c	17.1	72.1 ^c	26.9	84.1 ^c	32.9	96.1 ^b	38
10 Sec.	39.1 ^b	19.4	58.3 ^b	21.8	63.0 ^b	23.7	112.0 ^b	33.8
15 Sec.	12.5 ^a	8	67.7 ^c	18.6	79.5 ^c	25.9	71.9 ^a	28.4
20 Sec.	32.3 ^b	9.3	77.9 ^c	28.3	78.1 ^c	12.5	108.4 ^b	28.5
Total	28.5	19.6	60.8	28.6	67.6	29.1	102.9	88

Table (3) Interaction effect of dipping time and concentration, of coconut water on radicle length of the four cereals tested seedlings.

Treatment		Adana Wheat N=22		Smito Wheat N= 37		White Barley N= 35		Sorghum N= 42	
		Radicle length (mm)		Radicle length (mm)		Radicle length (mm)		Radicle length (mm)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Control		10.8 ^a	7.2	27.9 ^a	15.1	33.3 ^a	9.8	126.0 ^g	183.1
5 sec.	1%	26.5 ^c	13.6	48.5 ^d	24.6	72.7 ^f	25.1	84.2 ^f	27.4
	2%	7.4 ^a	6.5	54.7 ^e	27.9	70.4 ^e	25.7	53.7 ^c	18.5
	3%	26.4 ^c	21	62.1 ^f	27.8	73.5 ^g	25.4	81.7 ^f	26.4
	4%	33.4 ^e	23.7	69.6 ^f	22.6	86.5 ⁱ	25.4	87.8 ^f	26.4
10 sec.	1%	6.9 ^a	6.1	68.3 ^f	25.5	64.5 ^d	21.5	92.7 ^f	25.5
	2%	28.4 ^d	16.6	69.8 ^f	20.4	84.1 ⁱ	25.2	64.0 ^e	23.1
	3%	41.8 ^e	24.4	83.4 ^g	23.3	76.1 ^h	28.7	60.0 ^d	17.7
	4%	30.1 ^d	23.8	81.8 ^g	20	88.1 ⁱ	26.7	33.3 ^a	8.3
15 sec.	1%	25.8 ^c	12.1	58.8 ^f	20.5	73.7 ^g	18.3	86.4 ^f	37.8
	2%	14.8 ^b	9.9	57.1 ^e	23.5	79.8 ^h	19.9	62.7 ^e	22.1
	3%	31.1 ^e	19.64	68.6 ^f	14.7	83.8 ⁱ	19.8	74.0 ^f	32.6
	4%	32.1 ^e	9.8	37.9 ^c	20.9	88.7 ⁱ	34.9	47.9 ^b	16.9
20 sec.	1%	32.1 ^e	13.2	40.8 ^c	17	61.0 ^c	17.2	76.6 ^f	22.6
	2%	14.3 ^b	6.8	30.5 ^b	19.4	85.7 ⁱ	18.6	46.5 ^b	16
	3%	39.0 ^e	23.1	54.3 ^e	19.6	93.8 ⁱ	20.2	55.8 ^c	23.5
	4%	22.1 ^c	12.3	89.9 ^g	31.4	56.6 ^b	23.4	81.2 ^f	34.3
Total		24.9	18.8	59.1	28.2	74.8	27.2	71.5	54.3

Table (4) Effect of different concentrations of coconut water on plumule length of the four cereals tested seedlings.

Treatment	Adana Wheat N=22		Smito Wheat N= 37		White Barley N= 35		Sorghum N= 42	
	Plumule length (mm)		Plumule length (mm)		Plumule length (mm)		Plumule length (mm)	
	Mean	S. D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Control	24.6 ^c	7.2	21.1 ^a	8.4	34.9 ^a	13.8	54.8 ^c	16.2
1%	55.1 ^d	11	57.8 ^c	27.8	100.0 ^d	12.8	39.2 ^b	10.4
2%	19.5 ^b	15.7	38.8 ^b	24.2	79.3 ^c	13.8	44.5 ^b	14.5
3%	25.7 ^c	5.8	14.3 ^a	9.3	38.7 ^a	24.9	23.1 ^a	19.7
4%	11.2 ^a	5	13.5 ^a	9.7	55.2 ^b	29.1	23.7 ^a	15.7
Total	27.2	17.7	29	24.6	61.8	32	37.1	19.7

Table (5) Effect of different dipping times in coconut water on plumule length of the four cereals tested seedlings.

Treatment	Adana Wheat N=22		Smito Wheat N= 37		White Barley N= 35		Sorghum N= 42	
	Plumule length (mm)		Plumule length (mm)		Plumule length (mm)		Plumule length (mm)	
	Mean	S. D.	Mean	S.D.	Mean	S. D.	Mean	S. D.
Control	24.6 ^b	7.2	21.1 ^a	8.4	34.9 ^a	13.8	54.8 ^c	16.2
5 Sec.	28.1 ^b	12.2	62.1 ^c	28.7	69.2 ^c	30.2	43.0 ^a	17.2
10 Sec.	42.2 ^c	12.6	46.2 ^b	15.6	63 ^c	29.7	59.8 ^c	14.2
15 Sec.	30.5 ^b	14.9	58.2 ^c	20.1	74.1 ^c	25.9	48.3 ^b	14.5
20 Sec.	22.0 ^a	12.6	45.8 ^b	27.4	59.3 ^b	14.5	46.8 ^a	15.6
Total	29.5	13.9	46.7	25.6	60.1	27.3	50.5	16.6

Table (6) Interaction effect of dipping time and concentration, of coconut water on plumule length of the four cereals tested seedlings.

Treatment	Adana Wheat N=22		Smito Wheat N= 37		White Barley N= 35		Sorghum N= 42	
	Plumule length (mm)		Plumule length (mm)		Plumule length (mm)		Plumule length (mm)	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.

Control		24.6 ^d	7.2	21.1 ^a	8.4	34.9 ^a	13.8	54.8 ^d	16.2
5 sec.	1%	23.9 ^d	16.3	44.7 ^e	31.9	46.4 ^c	19.0	63.4 ^f	14.2
	2%	12.6 ^a	7.5	42.4 ^e	37.1	48.5 ^d	16.9	28.5 ^a	9.0
	3%	19.2 ^d	17.2	45.9 ^e	29.9	55.1 ^d	22.5	56.8 ^f	15.0
	4%	25.5 ^d	21.3	52.8 ^e	31.0	66.9 ^f	28.3	59.7 ^f	13.8
10 sec.	1%	12.1 ^a	9.1	54.5 ^e	35.0	57.9 ^e	20.2	58.3 ^f	17.1
	2%	18.1 ^c	13.3	51.4 ^e	31.8	46.8 ^c	12.8	55.9 ^e	19.4
	3%	25.0 ^d	13.9	48.4 ^e	32.7	48.2 ^d	19.1	33.3 ^b	10.3
	4%	21.3 ^d	21.3	53.0 ^e	22.6	58.2 ^e	26.0	37.7 ^b	9.4
15 sec.	1%	22.7 ^d	17.8	38.4 ^d	26.5	48.3 ^d	14.6	56.9 ^f	20.1
	2%	15.8 ^b	9.5	46.8 ^e	32.6	69.4 ^f	21.4	53.8 ^d	16.5
	3%	35.6 ^e	15.3	45.1 ^e	23.8	49.8 ^d	11.2	44.7 ^c	15.8
	4%	19.4 ^d	9.5	37.7 ^d	23.1	67.1 ^f	29.1	38.2 ^b	10.2
20 sec.	1%	16.6 ^c	9.2	30.1 ^c	27.9	35.2 ^a	19.2	62.7 ^f	11.3
	2%	19.1 ^d	10.9	26.2 ^b	19.0	54.0 ^d	19.4	46.8 ^c	10.8
	3%	26.8 ^e	18.2	40.8 ^e	22.5	53.7 ^d	11.7	30.9 ^a	12.2
	4%	29.0 ^e	15.1	54.7 ^e	25.1	37.3 ^b	16.4	58.4 ^f	21.2
Total		21.6	15.2	43.2	29.2	51.6	21.8	49.5	18.4

Discussion and conclusions

The effects of coconut water in different concentrations on plants seeds germination were in acceptance with those mentioned by other authors (Komgrit *et al.*, 2011; Chan and Elevitch, 2006), where both used different concentrations (0%, 2.5%, 5%, 7.5% and 10%). The dipping time treatment has not been trialed or mentioned in any literature in any citation and this is the first time to be trialed such effect or treatment for study. The concentration affected positively on radicles and plumules length for all plants specially the 1% which their effects were the higher than others. While the dipping time showed positive effect at both 5 and 10 seconds dipping time on both radicles and plumules while other times showed different effects. The interaction between

both treatments showed different affections on radicles where the radicles were affected positively and significantly in all dipping times at concentration of 4%. Plumules were more sensitive significantly positive at 4sec. in 4% concentration for adana soft wheat and so for smito hard wheat. White barley was positive and significant in 4% at the times 5 and 10 seconds, while the rest were affected in 2% concentration at 15 and 20 seconds. The sorghum seedling plumules were affected positively in 1% concentration at all dipping times except for 5 second dipping time was affected in 4% concentration. Simply these results are in agreement with the studies of (Agampodi and Jayawardena, 2009) and (Akhiriana *et al.*, 2019) in that they used IAA and coconut water in different concentrations and

combination of both. They noticed that adventitious plumule development and height, radicle emergence and development, and leaf emergence of the ornamental plant was supported by IAA of coconut water also they affected the seed germination.

Conclusion from results it has been that results showed concentration at 1% and dipping time with 10 seconds are the most active on enhancing radicle and plumule growth and percent germination. While the effect on interaction of both treatments were active at 15 and 20 seconds with all concentrations.

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