Journal of Food and Agriculture
DOI: http://dx.doi.org/10.4038/jfa.v15i2.5271

Impact of Seed Priming with King Coconut Water on Growth and Yield of Okra (*Abelmoschus esculents* L.)

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ABSTRACT

The pot experiment was carried out to study the effect of seed priming with coconut water on the growth and yield of okra (*Abelmoschus esculentus* L. Moench). It was carried out with six treatments comprised of different percentages of king coconut water, T1 - 0%, T2 - 4%, T3 - 8%, T4 - 12%, T5 - 16% and T6 - 20% in a Randomized Complete Block Design. The results confirmed that the seed priming with coconut water had significant differences in average values of plant height, number of leaves per plant, number of branches per plant, number of immature pods per plant, root length, number of seeds per immature pod, fresh weight of seed per pod, fresh weight of marketable pods per plant at each picking, total marketable pod weight (g) per plant, total marketable pod weight (g) per m² and total marketable pod weight (kg) per ha. But, average values of length, girth and fresh weight of immature pod were not significantly affected (P>0.05) by the seed priming treatment. According to the statistically analysed results, 12% king coconut water gave a higher marketable pod yield of okra which could be recommended for future use. Coconut water is a cheap and readily available resource, thereby it could be used for enhancing the growth and yield of crops by the seed priming induction process.

Keywords: Coconut water, Okra, Seed priming, Yield.

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INTRODUCTION

Agriculture is the primary source of income for the majority of the rural population in Sri Lanka, and vegetables are grown in all year round by most of the rural farmers. Okra (*Abelmoschus esculentus* L. Moench), known as Lady's finger is a vegetable plant in the Malvaceae family that grows as an annual vegetable crop in tropical and sub-tropical places around the world. It is a popular vegetable in Sri Lanka, ranked fourth based on cultivated extent among the low country vegetables as reported by AgSat (2007). It is a healthy vegetable crop popular for its soft and tasty pods. The okra

dried stems can be utilized as a source of paper pulp or fuel, while the foliage can be used for biomass (Sharma, 1993). Okra seeds have a lot of edible oil which is high in unsaturated fatty acids and protein (Oyelade *et al*., 2003). Okra immature pods contain dietary fiber, vitamins A, B, and C, as well as minerals such as calcium, phosphorus, and iron (Gemede *et al*., 2014; Sachan *et al*., 2017). It's high in nutrients and active components making it an antioxidant, anti-inflammatory, hypoglycemic, and hypolipidemic food (Chen *et al*., 2019). Okra has many health benefits for human immunity promotion, ageing prevention and health care (Ibeawuchi *et al*., 2005). In some regions, "okra" is also utilized as an antiulcer genic, gastro protective, and diuretic substance in folk medicine (Gurbuz, 2003).

Okra seeds are soaked in water overnight before sowing for softening the hard seed coat and improving seed germination. Seed hardness causes in reduced and delayed seed germination as well as inconsistent emergence in okra cultivation, (Purquerio *et al*., 2010). The stiff seed coat prevents water absorption and uniform growth of the embryo (Mereddy *et al*., 2015). Seed priming is an effective, eco-friendly method to enhance seed germination and seedling vigour (Nawaz *et al*., 2013; Anuj *et al*., 2021) and also to overcome the reduced and delayed germination in okra seeds caused by seed hardness (Anuj *et al*., 2021). Priming enhances some of the metabolic processes needed for seed germination and under stressful conditions, seed priming results in synchronized germination and enhanced seedling growth (Bajehbaj, 2010). When compared to non-primed seeds, primed seeds have higher growth potential and produce a higher yield (Huang *et al*., 2021).

The coconut (*Cocos nucifera* L.) fruit has a watery endosperm which is a multipurpose natural product and it is used all over the world as it is beneficial for health (Jean *et al*., 2009). King coconut (*Cocos nucifera.* L) is one of the varieties of green coconut and it belongs to the Arecaceae family. King coconut water contains a well-known source of sugars, amino acids, vitamins and minerals (Mantena *et al*., 2003). Auxin (IAA and ABA), gibberellins, and zeatin (cytokines) are phytohormones found in coconut water in varying concentrations (Tan *et al*., 2014), but the main contents are sugar and minerals (Prades *et al*., 2012).

Coconut water is reported to enhance the seedling germination more quickly (Saat *et al*., 2002). Immersion of seeds in coconut water had a considerable effect on the germination rate than the effect produced with other treatments (Patino *et al*., 2011). In all parts of Sri Lanka, coconut water is available in households and it can be used as a natural seed priming agent. The present study shows the effect of seed priming with coconut water on growth and yield of okra plants.

MATERIALS AND METHODS

Location

This study was carried out as a pot experiment in 2021 to study the impact of seed priming with king coconut water (*Cocos nucifera*) on the growth and yield of okra (*Abelmoschus esculentus* L) and also to determine the optimum concentration of king coconut water for seed priming in okra (*Abelmoschus esculentus* L) cultivation.

The experiment was done at home garden in Gonagala, Ruwanwella in the Kegalle district in Sabaragamuwa Province of Sri Lanka. The experimental site is located at 7° 05' latitude and 80° 25' longitude, and it is a part of the Sri Lankan wet zone low country (WL1). The temperature at the experimental site ranges from 26 °C to 28 °C. The annual mean rainfall is 2500mm, mostly distributed throughout the year. Relative humidity varies from 70% to 78% during day time and from 88% to 94% during nighttime. The experimental site's soil type is red-yellow podzolic soil.

Experimental Design

The experiment was carried out in a Randomized Completely Block Design (RCBD) with six treatments having five replicates. The treatments used in this experiment are as follows.

T1: Distilled water as control (0% king coconut water)
T2: 4% king coconut water
T3: 8% king coconut water
T4: 12% king coconut water
T5: 16% king coconut water
T6: 20% king coconut water

Coconut Water Preparation

King coconut was collected from Thalduwa rural market in Kegalle district, Sri Lanka, then it was cut and coconut water was poured into the cleaned jug. After filtering the coconut

water, 100 ml of coconut water was measured by using measuring cup and it was considered as 100% of king coconut water. Subsequently, the different concentrations (4% - 20%) of coconut water were prepared by mixing of king coconut water and distilled water according to the treatments. Then each prepared concentration was added into the separated cups for soaking of okra seeds for 12 hours.

Agronomic Practices

Okra variety, Haritha was used in this experiment which is mostly resistant to yellow vein mosaic disease. For the experiment, black polybags (60 cm length and 45 cm diameter) were used. A potting mixture (top soil: sand at 1:1 v/v ratio) was used to fill all of the polybags. Each polybag was filled to the top of the polybag, leaving ¼ of space between the soil and the top of the polybag. Holes were made in the bottom of the bags for drainage purposes. All of the pots were kept in the experiment area as the spacing of 60 cm x 60 cm. Seeds of okra variety Haritha were collected from Seed selling Centre, Polonnaruwa and thereafter, seeds were separately immersed in the prepared coconut water concentrations for 12 hours. After 12 hours of soaking, the seeds were kept on the filter paper for draining water. Small holes were punched in the middle of the polybag, and two pre-soaked okra seeds per polybag were sown at a depth of 1-2 cm. Thinning out was done two weeks after planting to keep one plant per polybag.

In this experiment, 10 t/ha of organic manure was added at 3:2 rate of cow dung: poultry manure as basal fertilizer according to Viharnaa and Seran (2012). The applied amount of manure was calculated according to the polybag size. Further, as per the recommendation of the Department of Agriculture, Sri Lanka, chemical fertilizers (150 kg/ha urea and 75 kg/ha muriate of potash) were applied as topdressing fertilizers. The basal application was done before the seeds were planted, and the top dressing was done four weeks after seeding. Irrigation was done with a watering can from seeding to germination twice a day in the early morning and late evening then, once a day in the evening until pod formation. After that it was done once in two days in the evening. Weeding was manually done at two weeks interval.

Measurements

Growth parameters were taken at every two weeks intervals. The plant height was measured with a measuring tape from the ground surface to the tip of the terminal bud. The total number of branches that had at least one enlarged leaf, was counted that developed in stem and the number of fresh leaves and flowers were counted per plant. The days to 50% and 100% flowering were recorded after seeding. Plants were uprooted after the 9th week of sowing and the root length was measured with a ruler from the ground surface to the tip of the main root. Subsequently, the fresh weight of leaves, stems and roots was measured by using an analytical balance.

Harvesting was started at the 6 th week after planting in harvesting stage of okra. Marketable pods were harvested for four times. The number of pods in each plant was counted at each picking. The length of the pod was measured between the tip of the pod and the base of the pod by using a measuring tape at each picking separately. Three different points of the pod were selected and the pod girth was measured separately using a thread and ruler and then average pod girth was taken at each picking separately. The fresh weight of the pod was measured by measuring analytical balance at each picking. The number of seeds per pod was counted at every picking and the average value was taken and then the fresh weight of the seeds was measured by using analytical balance at each picking. Marketable pod weight per plant at each picking was recorded and cumulative pod yield was calculated by the accumulation of pod weight per plant at each picking.

Statistical Analysis

The data were analyzed using statistical software, SAS 9.1 version. Duncan's Multiple Range Test was used to compare the treatment means at a 5% significant level.

RESULTS AND DISCUSSION

This experiment was carried out to study the impact of seed priming with coconut water on the growth and yield of okra (*Abelmoschus esculentus* L.) and also to study the best concentration of coconut water for seed priming to the growth and yield of okra (*Abelmoschus esculentus* L).

Seed Germination %

Figure 1 indicates that seed germination % of the okra after seed priming with different concentrations of coconut water. It was recorded that there was a minimum germination % in T1 (control treatment) and maximum germination % in T6 at 6 days after seeding. The finding is supported by Sharma *et al*., (2014) who reported that seed treatment with the coconut water solution was more effective in improving the rate of germination. As per Chuwang *et al*., (2018), seed priming with coconut water had the highest germination %. It may be due to soaking in coconut water which contains various active substances like minerals, glucose and protein.

In general, pre-soaking of the seeds is practiced to break dormancy and obtain uniform seed growth. This seed treatment allows induction of physiological and biochemical processes in the pre-germination phase of seeds. Our result is in line with the findings of other researchers, seed priming resulted in a significant rise in germination percentage (Mohammadi *et al*., 2014; Oliveira *et al*., 2019). Narsai *et al*., (2015) stated that if seeds are soaked for a too long period, germination of seeds becomes difficult due to lack of oxygen.

Plant Height

Plant height was significantly varied ($P<0.001$) from 2nd to 8th week after

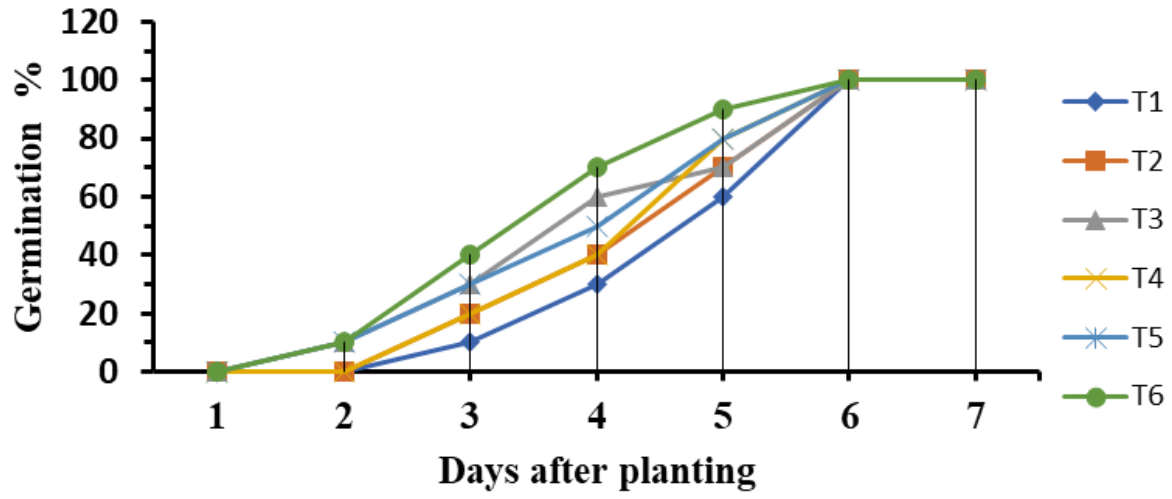

Figure 1. Effect of seed priming with coconut water on seed germination % of okra.

planting (WAP) (Table 1). At 2nd WAP, tallest plant was recorded in T6 (16.42 cm), followed by T5 (16.04 cm) and T4 (14.90 cm) while the lowest plant height was recorded in T1 (13.52 cm). At the 8th WAP, maximum plant height (62.12 cm) was recorded in T6 which was treated with 20% coconut water concentration and the minimum plant height (38.90 cm) was recorded in T1 (control treatment). These results are in agreement with Chuwang *et al*., (2018) who stated that the plant height of pepper (*Capsicum* spp) plant was considerably enhanced by the seed priming with coconut water as compared with controlled one. Amarnath *et al*., (2018) mentioned that the plant height could be increased in the sorghum (*Sorghum bicolor* L.) plant when the level of coconut water concentration was increased in soaking seeds.

Auxin (IAA and ABA), gibberellins and zeatin are found in various levels in coconut water which is a natural source of growth regulators (Oka, 2014). And also, coconut water contains essential elements such as potassium and calcium (Anurag and Rajamohan, 2003). The seedling emergence is quicker in primed seed treatment as a result plants developed in treated seeds may taller. This is in accordance with Abdul *et al*., (2011) who stated that priming increased seedling vigour, increasing competition for light, water, and nutrients.

Number of Leaves per Plant

Number of leaves per plant of okra at different weeks is shown in Table 2. There was no remarkable difference ($P>0.05$) in number of leaves per plant at 2nd week after planting (WAP). Seed priming with different coconut water concentrations significantly influenced ($P<0.001$) the number of leaves per plant from 4th to 8th WAP. At 4th, 6th and 8th WAP, the highest numbers of leaves were observed in T6 and the lowest numbers of leaves were observed in T1 (control treatment). The findings are in agreement with Nwonuala *et al*., (2021) who stated that the number of leaves of bitter kola (*Garcinia kola*) plant was significantly enhanced by the seed priming with coconut water compared with the control. The number of leaves per plant is an important factor because photosynthesis, carbon uptake and assimilation, transpiration, and the emission of volatile organic compounds are carried out completely by plant's leaves.

Table 1. Effect of seed priming with different coconut water concentrations on plant height of okra at different weeks.

Treatments	Plant height at different weeks			
	2nd week	4th week	6th week	8th week
T1	13.52±0.39c	27.98±0.70c	30.68±0.56c	38.90±0.87c
T2	14.52±0.54bc	30.56±0.89bc	34.44±0.65abc	56.16±1.15ab
T3	14.62±0.27bc	29.38±1.56c	33.06±1.32bc	52.06±2.75b
T4	14.90±0.38abc	32.72±1.66abc	37.46±1.11ab	58.70±0.88a
T5	16.04±0.41ab	35.20±0.74ab	39.12±1.16a	61.34±1.13a
T6	16.42±0.32a	36.48±0.44a	39.70±2.27ab	62.12±1.05a
F test	P<0.001	P<0.001	P<0.001	P<0.001

Value represents mean ± standard error of five replicates. Means followed by the same letter in each column are not significantly different according to the Duncan's Multiple Range Test at 5% significant level.

Table 2. Effect of seed priming with coconut water on number of leaves per plant of okra at different weeks.

Treatments	Number of leaves per plant at different weeks			
	2nd week	4th week	6th week	8th week
T1	5.0±0	7.0±0c	8.0±0.3c	12.0±0.6b
T2	5.0±0	7.8±0.2bc	10.2±0.2b	17.0±0.3a
T3	5.0±0	8.8±0.2ac	10.8±0.4ab	17.0±0.6a
T4	5.0±0	8.2±0.5abc	11.0±0.6ab	17.6±0.4a
T5	5.0±0	9.4±0.4a	11.6±0.5ab	17.8±0.4a
T6	5.0±0	9.4±0.4a	12.4±0.4a	18.4±0.4a
F test	P>0.05	P<0.001	P<0.001	P<0.001

Values represent the mean ± stand error of five replicates. Mean values in a column having the dissimilar letters indicate significant differences at 5% level of significance according to Duncan's Multiple Range Test.

Number of Branches per Plant

Number of branches per plant of okra at two weeks intervals is shown in Table 3. There were no significant differences (P>0.05) in number of branches per plant at 4th and 6th WAP. Seed priming with different coconut water concentrations significantly influenced (P<0.001) the number of branches per plant at 8th WAP. Highest number of branches was recorded in T6 (7.0) at 8th

WAP and the lowest number of branches was recorded in T1 (5.2).

Days for 50% and 100% Flowering

Days for 50% and 100% flowering of okra variation due to the seed priming with coconut water is presented in Figure 2. A minimum duration of 36 and 39 days was taken by T6, followed by T3 (37 and 39 days) to attain 50% and 100% flowering, respectively. The longer time period with 40 and 44 days was taken in T1 for 50% and 100% flowering, respectively.

Pod Length

The data presented in Table 4 clearly indicates that there was no significant effect ($P>0.05$) on the immature pod length of okra after seed priming with different coconut water concentrations. The maximum pod length was recorded in T6 (16.16 cm), followed by T5 (15.87 cm) and T3 (15.78 cm). The minimum pod length was recorded in T1 (15.55 cm) compared to all the treatments where seeds were treated with different coconut water concentrations. The average pod length of all the treatments ranged from 15.55 cm (T1) to 16.16 cm (T6). Colpan *et al*., (2013) noted that pods are small when potassium levels are low but pods are too large when potassium was high. An increase in the pod length causes increasing in pod size and ultimately the pod yield of okra.

Pod Girth

The data presented in Table 4 shows that the seed priming with coconut water has not significantly affected ($P>0.05$) in the average girth of pods. The maximum average girth of immature pod was 5.82 cm in T3 and the minimum average girth of the immature pod was 5.66 cm in T6. Mean values in a column having the similar letter indicate that there is no considerable variation between the treatments. The existence of micronutrients is involved in the cellular mechanism and the respiration rate that positively affect the increase in pod size (Polara *et al*., 2017).

Number of Pods per Plant

Seed priming with coconut water influenced the total number of pods per plant which is confirmed with $P<0.05$ values (Table 4). The minimum number of pods per plant was reported in T1

Table 3. Effect of seed priming with coconut water on number of branches per plant at different weeks.

Treatments	Number of branches per plant at different weeks		
	4th week	6th week	8th week
T1	1.4±0.2	3.2±0.2	5.2±0.2c
T2	1.2±0.4	3.2±0.2	5.4±0.2bc
T3	1.6±0.2	3.2±0.2	6.0±0bc
T4	1.6±0.2	3.2±0.2	6.2±0.2ab
T5	1.8±0.2	3.4±0.2	6.2±0.2ab
T6	2.2±0.2	3.8±0.4	7.0±0.3a
F test	P>0.05	P>0.05	P<0.001

Values represent the mean ± standard error of five replicates. Mean values in a column having the dissimilar letters indicate significant differences at 5% level of significance according to Duncan's Multiple Range Test.

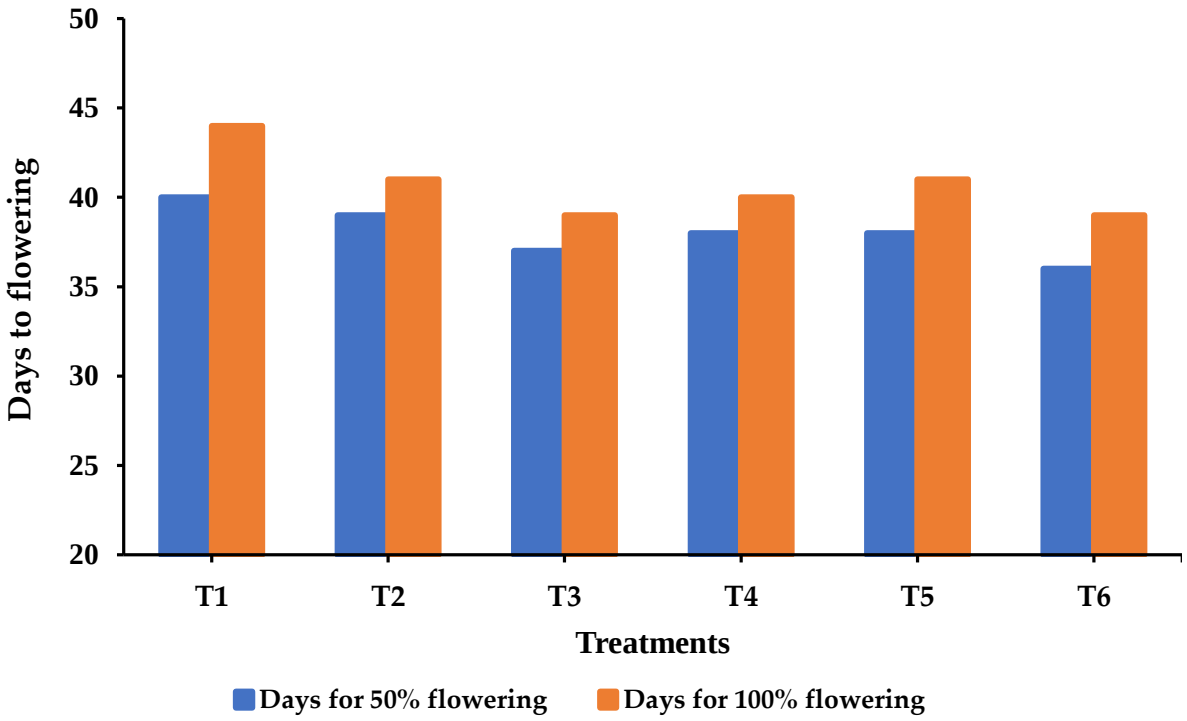

Figure 2. Effect of seed priming with coconut water on days taken at 50% and 100% flowering of okra.

Table 4. Effect of seed priming with coconut water on average immature pod length, pod girth and number of pods per okra plant.

Treatments	Average length of immature pod (cm)	Average girth of immature pod (cm)	Number of immature pods per plant
T1	15.55±0.18	5.78±0.09	4.2±0.4b
T2	15.61±0.28	5.70±0.07	4.8±0.2ab
T3	15.78±0.30	5.82±0.05	5.2±0.6ab
T4	15.67±0.20	5.71±0.06	6.2±0.4a
T5	15.87±0.14	5.69±0.10	6.0±0.5a
T6	16.16±0.20	5.66±0.10	5.6±0.7ab
F test	P>0.05	P>0.05	P<0.05

Value represents mean ± standard error of five replicates. Means followed by the same letter in each column are not significantly different according to the Duncan's Multiple Range Test at 5% level.

(4.2) while the maximum number of pods per plant was reported in T4 (6.2) at harvest time. There is no substantial difference in number of pods between T4 and T5 which significantly varied from T1.

Coconut water contains nutritional elements such as potassium. The finding is in accordance with Colpan *et al*., (2013) who stated that pods are small at low potassium levels while pods are too large at high potassium levels. The treatment of mature coconut water enhanced the availability and uptake of primary nutrients (N, P, and K) in the soil, resulting in a higher number of pods in green gram plant (Sankar *et al*., 2020). The Ullah *et al*., (2002) also stated similar results that priming increases number of primary branches per plant and number of pods per plant.

Number of Seeds per Pod

There was a remarkable variation (P<0.05) in average number of seeds per immature pod (Table 5). Significantly the highest number of seeds (52.4) was (P<0.05) observed in T4 among the treatments except for T5 and the lowest number of seeds (45.1) was observed in T1. There was no significant variation (P>0.05) between T2 and T6 for the number of seeds per pod.

Immature Pod Weight

The fresh weight of immature okra pod did not show significant differences ($P>0.05$) by the seed priming with coconut water (Table 5). According to the statistically analyzed data, maximum fresh pod weight was observed in T6 (20.50 g) followed by T5 (20.24 g) at the harvest. The minimum pod weight was observed in T1 (19.17 g) which was the control treatment. The treatments which were treated with different coconut water concentrations had higher pod weights compared to the control treatment although the differences were not statistically significant.

Seed Weight per Pod

Table 5 represents the different coconut water concentrations based seed priming on fresh weight of seeds per pod of okra. There was a significant variation ($P<0.05$) in fresh weight of seeds per pod by using seed priming with coconut water of okra. The maximum fresh weight of seeds per plant was recorded in T4 (4.89 g), followed by T5 (4.69 g), T2 (4.53 g) and T3 (4.51 g). The minimum fresh weight of seeds per plant was recorded in T6 (4.43 g). Zare and Vazin (2013) stated that 1000 seed weight was significantly increased by effect of potassium like micronutrients and coconut water might have given some force for uptaking nutrients from soil.

Root Length

There was a significant difference ($P<0.001$) in root length (Table 6). The highest root length was recorded in T6 (42.34 cm), followed by T5 (40.86 cm) and T4 (36.86 cm) while the lowest root length was recorded in T1 (15.80 cm). This result is in line with Marne *et al*., (2020) who noted that root length was increased by coconut water primed Kamagong (*Diospyros discolor*) plants than that of controlled plants. According to Setyaningsih *et al*., (2019), soaking with coconut water has a considerable effect on the growth of the King palm roots. The longer soaking the longer the roots produced. It was noted that seed priming with fresh coconut water had the highest root length which might be due to increase in cell division within the apical meristem of seedling roots because of the plant growth hormones present in the coconut water as stated by Kende *et al*., (1998). Increment in root and shoot length due to seed priming treatment was also reported by Dubey *et al*., (2007) and

Tian *et al.,* (2014). According to Vanajah (2019) coconut water had significant effect on the root length of Peppermint (*Mentha piperita* L.) stem cuttings.

Fresh Weight of Leaves per Plant

After the 9th week, the fresh weight of leaves was measured and it was significantly affected (P<0.001) by seed priming with coconut water (Table 6). Maximum fresh weight of okra leaves was recorded in T6 (24.08 g) followed by T5 (23.56 g) while the lowest fresh weight of okra leaves was recorded in T1 (13.87). There was no significant difference (P>0.05) between T5 and T6 for fresh weight of okra leaves per plant. Zainudin and Adini (2019) reported that interaction between concentration of coconut water and duration of seed immersion can influence the fresh weight of leaves of plants. Usually a higher biomass of plant indicates that the plant's growth and development proceed normally by coconut water induced seed priming.

Fresh Weight of Stem per Plant

Table 6 shows the effect of seed priming with coconut water on the fresh weight of stem. The seed priming with coconut water had a highly significant effect (P<0.001) on the fresh weight of stem of okra plant. There was variation (P<0.05) between treated and untreated seeds for fresh weight of okra stem thus increasing trend was obtained from seeds that were primed and it is conformed to the report of Wasif *et al.,* (2012) who reported rapid plant growth in primed seeds.

Fresh Weight of Roots per Plant

The seed priming with different coconut water concentrations had a significant effect (P<0.001) on the fresh weight of roots of okra plant among treatments (Table 6). The maximum fresh weight of roots was recorded in T6 (20.88 g) and the lowest fresh weight of roots was recorded in T1 (6.98 g). Fresh weight of roots was influenced by number and length of roots. The fresh weight of root of papaya was increased by using seed priming with high concentration of coconut water (Zainudin *et al.,* 2019).

Immature Pod Weight per Plant

Table 7 shows the fresh weight of immature (marketable) pods per plant at each picking. There was no significant difference in the fresh

Table 5. Effect of seed priming with coconut water on average number of seeds per pod, fresh weight of immature pod and fresh weights of seeds per immature pod of okra.

Treatments	Number of seeds per immature pod	Fresh weight of immature pod (g)	Fresh weight of seeds per immature pod (g)
T1	45.1±1.4c	19.17±0.45	4.45±0.07b
T2	46.8±0.5bc	19.87±0.56	4.53±0.08ab
T3	45.8±1.5c	19.98±0.62	4.51±0.05ab
T4	52.4±1.5a	19.41±0.38	4.89±0.12a
T5	51.2±2.4ab	20.24±0.10	4.69±0.07ab
T6	46.9±2.4bc	20.50±0.53	4.43±0.10b
F test	P<0.05	P>0.05	P<0.05

Value represents mean ± standard error of five replicates. Means followed by the same letter in each column are not significantly different according to the Duncan's Multiple Range Test at 5% level.

Table 6. Effect of seed priming with coconut water on root length and fresh weights of leaves, stem, roots and crop residue per plant.

Treatments	Root length (cm)	Fresh weight (g) of plant parts per plant after harvesting		
		Leaves	Stem	Root
T1	15.80±0.35e	13.87±0.74e	19.51±0.25e	6.98±0.12e
T2	28.34±0.66d	19.10±0.34d	34.83±1.20d	14.76±0.29d
T3	34.18±0.73c	21.65±0.14c	37.46±0.52c	16.93±0.47c
T4	36.86±0.45b	22.77±0.09b	39.64±0.87b	18.58±0.33b
T5	40.86±0.47a	23.56±0.25a	41.54±0.52b	19.98±0.30a
T6	42.34±0.73a	24.08±0.13a	46.06±0.36a	20.88±0.47a
F test	P<0.001	P<0.001	P<0.001	P<0.001

Value represents mean ± standard error of five replicates. Means followed by the same letter in each column are not significantly different according to the Duncan's Multiple Range Test at 5% level.

Table 7. Effect of seed priming with coconut water on fresh weight of immature (marketable) pods per plant at each picking.

Treatments	Fresh weight (g) of marketable pods per plant at each picking			
	First picking	Second picking	Third picking	Fourth picking
T1	11.73±4.79	30.42±5.43	23.72±4.78b	15.95±4.02
T2	20.29±6.55	26.95±3.81	36.57±8.64ab	12.10±4.98
T3	21.04±7.00	35.37±6.71	28.65±6.77ab	19.24±0.85
T4	14.87±3.79	40.98±3.40	49.63±4.55a	21.68±7.38
T5	20.24±6.44	38.64±5.78	42.06±6.58ab	20.50±5.99
T6	20.54±6.53	35.01±6.72	36.24±8.79ab	21.32±6.32
F test	P>0.05	P>0.05	P<0.05	P>0.05

Value represents mean ± standard error of five replicates. Means followed by the same letter in each column are not significantly different according to the Duncan's Multiple Range Test at 5% level.

weight of marketable pods per plant at first, second and fourth pickings. But there was significant variation in fresh weight of marketable pods among the treatments in third picking. The maximum fresh weight of marketable pods was recorded at first picking in T3 (21.04 g), at second picking in T4 (40.98 g), at third picking in T4 (49.63 g) and at fourth picking in T4 (21.68 g). The minimum fresh weight was recorded in T1 (11.73 g), T2 (26.95 g), T1 (23.72 g) and T2 (12.10 g) at the first, second, third and fourth pickings, respectively.

Marketable Pod Yield

Table 8 shows that there is a significant difference (P<0.05) in total marketable pod yield by the treatment of seed priming with coconut water. T4 (127.16 g) was recorded as the maximum and T1 (81.82 g) was recorded as the minimum total pod weight (g) per plant. The maximum total pod weight (353.22 g/m^2) was recorded in T4 and minimum (227.29 g/m^2) was in T1. The marketable pod yield per hectare was highest in T4 (3532.22 kg/ha) and lowest in T1 (2272.89 kg/ha). There was no significant variation on pod weight (g) per plant, total pod weight (g) per m^2

Table 8: Effect of seed priming with coconut water on total pod weight per plant and marketable pod yield of okra.

Treatments	Total pod weight per plant (g)	Total pod weight (g/m^2)	Total marketable pod yield (kg/ ha)
T1	81.82±8.69b	227.29±24.15b	2272.89±241.49b
T2	95.91±5.73ab	266.42±15.92ab	2664.17±159.19ab
T3	104.30±13.31ab	289.72±36.97ab	2897.22±369.67ab
T4	127.16±7.33a	353.22±20.37a	3532.22±203.68a
T5	121.44±10.07a	337.34±27.99a	3373.44±279.85a
T6	116.11±13.18a	332.53±36.60a	3225.33±365.98a
F test	P<0.05	P<0.05	P<0.05

Value represents mean ± standard error of five replicates. Means followed by the same letter in each column are not significantly different according to the Duncan's Multiple Range Test at 5% level.

and total marketable pod yield (kg/ha) among T4, T5 and T6.

CONCLUSION

Treatments of different coconut water concentrations with seeds of okra had significant effects on some tested parameters of okra. The results confirmed that the seed priming with coconut water had an effect of early germination. Plant height was significantly (P<0.001) different among coconut water treated seeds derived plants and the tallest plants were recorded in 20% coconut water treatment while the lowest height was recorded in control treatment. In parameters such as number of leaves per plant, number of branches per plant, root length and fresh weight of leaves, stems and roots after harvesting were significantly higher in 20% coconut water treatment than that of control treatment.

Further, there was a significant difference (P<0.05) in the average number of immature pods per plant, total pod weight (g) per plant, total pod weight (g) per m^2, total marketable pod yield (kg/ha) among coconut water treated seeds derived plants. There were significant differences (P<0.05) in number of seeds per immature pod and average fresh weight (g) of seeds per immature pod among the treatments. Accordingly, 20% coconut water

concentration (T6) for seed priming was the best treatment when considering growth parameters of okra while 12% coconut water concentration (T4) treated seed priming showed the highest average number of immature pods per plant, total pod weight (g) per plant, number of seeds per immature pod, average fresh weight (g) of seeds per immature pod, total pod weight (g) per m^2 and total marketable pod yield (kg/ha). Therefore, 12% coconut water could be used for seed priming of okra crop to increase crop yield.

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