Forests and Forest Products Journal 9:42-54

Effects of Fresh Cow Milk and Coconut Milk on the Germination of *Tamarindus indica* Seeds

*[1]ADELANI, D. O; [1]EMEGHARA, U.U and [2]OYEBAMIJI, N.A
1 Federal College of Forestry Mechanization, P.M.B 2273 Afaka, Kaduna
2 Department of Forestry and Wildlife Management, Federal University Dutsinma, PMB 500, Katsina State, Nigeria
*Corresponding Author. E-mail: adelani.olusegun@yahoo.com
Phone: 07038953146

Abstract

To meet the current demand for the forest products through domestication, there is need to embrace cheap, fast, natural, accessible and adoptable physiological techniques that relief photo, thermo, physiological as well as mechanical dormancy. There is dearth of quantified information on the effects of natural sources of hormones on the seeds of agro-forestry tree species. In light of this, these experiments were conducted to assess the effects of fresh cow milk and coconut milk on the germination percentage and mean germination time of *Tamarindus indica* seeds. Two experiments were laid out in split-plot experimental design with four replicates to assess the effect of concentrations of fresh cow milk (25, 50, 75 and 100%) and treatment times (0, 6, 8, 12 and 14hours) and concentrations of coconut milk (25, 50, 75 and 100%) and treatment times (0, 6, 8, 12 and 14hours) on the germination of seeds. Result revealed that the percentage germination value of seeds soaked in all concentrations of fresh cow milk for all hours of treatments ranged from 70% to 100%. The percentage germination ranged from 65% to 100% for all concentrations and treatment times of seeds treated in coconut milk. A significant germination percentage value of 100% was recorded for seeds treated for 14hours in 50% and 100% concentrations of coconut milk and fresh cow milk respectively. These results are recommended for mass production of *Tamarindus indica* seedlings for agro-forestry programmes.

Key words: Fresh cow milk, Coconut milk, Hormones, Germination, Physiology.

Introduction

Tamarindus indica is widely distributed in Sudan and other Afro-Asian countries (Warda *et al.,* 2007). The species is indigenous to tropical Africa, particularly in the Sudan and cultivated in Cameroon, Nigeria and Tanzania (Morton, 1987). It belongs to the dicotyledonous family Leguminosae, sub family Caesalpiniaceae which is the third largest family of flowering plants with a total of 727 genera and 19,327 species (Lewis *et. al.,* 2005). It is commonly called Tsamiya, Icheku oyibo, Ajagbon, Tamarind in Hausa, Ibo, Yoruba and English languages respectively. Its young seedlings, leaves and flowers of mature trees are eaten as vegetables and in curries, salads and soup. Its sour prods are cooked as seasoning with rice, fish and meats. Its fruit pulp is used for the preparation of beverages in different regions (Samina *et al.,* 2008).

It contains high level of protein with many essential amino acids which help to build strong and efficient muscles. It is also high in carbohydrate, which provides energy, rich in the minerals, potassium, phosphorus, calcium and magnesium. It can also provide smaller amounts of iron and vitamin A. Phytochemical investigations of the aerial parts of this plant have demonstrated the presence of tartaric, acetic, citric and succinic acids, gum, pectin, sugar, tannins, alkaloids, sesquiterpenes and glycosides (Aida *et al.,* 2001). It is a plant widely used in traditional medicine in Africa for the treatment of many diseases such as fever, dysentery, jaundice, gonococci and gastro intestinal disorders (Ferrara, 2005). Pharmacological investigation on *T. indica* extracts reported them to have antibacterial, antifungal, hypoglycaemic, cholesterolemic, cytotoxic, anti- inflammatory, gastrointestinal (Coutino-Rodriguez *et al*., 2001), hypolipomic and antioxidant activities (Ferrara, 2005; Martinello *et al.,* 2006). *T. indica* extracts were found to have anti-miracidial and anti-cercarial activities, anti-diabetic potency and anti-*Burkholderia pseudomallei* (*Pseudomonas pseudomallei*) activity (Rajkumar *et al*., 2005).

In spite of the enormous potentials of *T. indica*, it is still faced with low rate of domestication as a result of dormancy of its seeds (Ajiboye *et al.,* 2009). Ajiboye (2010) reported that the *T. indica* seeds do not germinate when placed under conditions which are normally regarded as favourable for germination and therefore, it is dormant and could be induced to germinate. Inadequacy of simple, cheap, fast, natural, accessible and adoptable modern physiological methods as the use of fresh cow milk and coconut milk to break dormancy of the *T. indica* reduce its domestication rate. Most of the methods of physical, chemical and mechanical scarification cannot relief the seeds of multiple and double dormancy as hormone (Schmidt, 2000). They do not help to overcome physiological dormancy of seeds (Habib *et al.,* 2015). They only degrade the seed coat for germination (Aliero, 2004; Abubakar and Muhammad, 2013); without rapidly and uniformly influencing the physiology of the seeds (Dewir *et al.,* 2011) and seedlings Gehlot and Kasera, 2012).

However, hormones help to relief photo, thermo and physiological dormancy in seeds (Schmidt, 2000) as well as encourage mass production of seedlings for agro-forestry programmes (Adelani *et al*., 2014a). There is dearth of quantified information on the effect of natural sources of hormones on the seeds of agro-forestry tree species compared to synthetic sources. In light of this, these experiments were conducted to assess the effect of fresh cow milk and coconut milk that contain hormones (Adelani and Maisamari, 2016) on the germination and mean germination time of *T. indica*.

Materials and Methods

Experimental Site

The pot experiment was carried out at the nursery of Federal College of Forestry Mechanization, Afaka, Kaduna.. The college is situated at about 30km along Kaduna- Lagos road, Igabi Local Government Area of Kaduna state, Nigeriabetween latitude 10^{o} 35^{1} and 10^{o} 34^{1} and longitude 7^{o} 21^{1} and 7^{o} 20^{1} (Adelani, 2015). Rainfall is approximately 1000mm annually with the lowest monthly relative humidity averaging 29%. The vegetation is open woodland with tall trees, usually small boles and broad Leaves (Otegbeye *et al*., 2001).

Experimental Procedure

The fruit were sourced from the mother tree in front of new Auditorium of the College. The sand from 2mm sieve was collected from the college dam and sterilized at 160^{o}C for 24 hours. The viability of the randomly selected seed samples was assessed by cutting method (Schmidt, 2000). The poly pots of $20x25x25cm^{3}$ were filled with the sterilized sand in the nursery (Adelani *et al.,* 2014b). The preparation of coconut milk involved equal mixture of coconut water and endosperm extract.

Experiment 1: Effect of fresh cow milk on the germination of the *T. indica* seeds

To investigate the effect of fresh cow milk on the germination of the *T. indica* seeds, a split-plot experimental design with four replications was involved. Four concentrations of fresh cow milk (25, 50, 75 and 100%) and five treatment times (0, 6, 8, 12 and 14 hours) constituted main and sub plot treatments respectively. Eight hundred (800) *T. indica* seeds were extracted from the fruits. The seeds were washed and air dried. Forty (40) seeds were soaked in four concentrations of fresh cow milk (25, 50, 75 and 100%) for 0, 6, 8, 12 and 14 hours. The concentration of fresh cow milk was prepared in the laboratory. After treatment, seeds were washed with distilled water and air dried for 30minutes and treated with fungicides (vinclozolin). Treated seeds were planted in 4cm depth of sterilized sand and 80ml of water per seed was applied regularly at two days interval (Adelani and Maisamari, 2016). Seeds that were soaked in water served as control. A seed was considered germinated when the radicle was able to break open the seed coat at the sight of plumule emergence.

Experiment 2: Effect of coconut milk on the germination of *T. indica* seeds

The effect of coconut milk on the germination of *T. indica* seeds was assessed using a split- plot experimental design with four replications. Four concentrations of coconut milk (25, 50, 75 and 100%) and five treatment times (0, 6, 8, 12 and 14hours) constituted main and sub- plot treatments respectively. Eight hundred (800) seeds were extracted from the fruits. The seeds were washed and air dried. Ten (10) seeds represented a replicate. Forty seeds were soaked in the four concentrations of coconut milk (25, 50, 75 and 100%) for five treatment times (0, 6, 8, 12 and 14 hours). The concentration of coconut milk was prepared in the laboratory. After treatment, seeds were washed with distilled water, air dried for 30 minutes and treated with fungicides (vinclozolin). Treated seeds were planted in 4cm depth of sterilized sand and 80ml of water per seed was applied regularly at two days interval (Adelani and Maisamari, 2016). Seeds that were soaked in water served as control. A seed was considered germinated when the radicle was able to break open the seed coat at the sight of plumule emergence. Germination percentage and mean germination time was calculated for both experiments using the following formula:

$$\text{Germination Percentage} = \frac{\text{Total seed germinated}}{\text{Total seed sown}} \times 100$$

Mean germination time was calculated using the relation

$$\text{MGT} = \frac{\Sigma(f_x)}{\Sigma x}$$

Schelin *et al.* (2003)

Where x is the number of newly germinated seeds on each day, f is the number of days after seeds were set to germinate. X is the Total number of seeds that germinated at the end of the experiment.

Data Analysis

The data collected on the effect fresh cow milk and coconut milk on seed germination and mean germination time was subjected to one way analysis of variance (ANOVA) using SAS (2003) software. Mean separation at 5% significant level of probability was carried out using Least Significant Difference (LSD). All percent germination data were arcsine-square root transformed prior to analyses because it is appropriate for data on proportions, data obtained from a count, and data expressed as decimal fractions or percentages (Gomez and Gomez, 2010; Sananse and Maidapwad, 2014) covering a wide range (Akindele, 2004).

Results and Discussion

Hormonal composition of coconut milk and fresh cow milk

The result of the hormonal analysis is represented in Table1.Coconut milk had 1.52, 0.023 and 0.092 µg/ml of IAA, GA_3 and ABA. Fresh cow milk had 0.012 and 0.006 µg/ ml for IAA and ABA. The excellent performance of fresh cow milk in releasing the dormancy could be traced to the presence of hormones as IAA and ABA (Table 1). “Cow’s milk (organic or otherwise) has been shown to contain 35 different hormones and 11 growth factors,” (Djamgoz and Jane, 2015). Growth regulators are organic substances besides nutrients, synthesized in plants, causing alteration in their cellular metabolism (Rastogi *et al.,* 2013). These hormones release the dormancy of plant seeds**.** Various studies of hormonal treatments in different crops, viz. *Albizia lebbeck*, *Senna siamea*, *Prosopis africana* and *Parkia biglobosa* (Ebofin *et al*., 2003) and in *Lagenaria siceraria* (Vwioko and Longe 2009) also supported the results of the present research that hormones release dormancy in seeds. The smoke dried seeds yield 73% while the mechanical scarified seeds and the seed soaked in 1AA for 24 h after cracking the testa had 70 and 90% seed germination respectively (Ehiagbonare and Onyibe , 2007).

Table 1: Hormonal composition of coconut milk and fresh cow milk

S/N	Sample	IAA µg/ml	GA_3 µg/ml	ABA µg/ ml
1	Coconut Milk	1.52	0.023	0.092
2	Fresh cow milk	0.012	Not detected	0.006

Effect of fresh cow milk on the germination of *T. indica* seeds

The result of the effect of concentrations and treatment times of fresh cow milk on the germination of *T.indica* seeds is presented in Table 2. Irrespective of treatment time, germination percentage values of seeds soaked in 25% and 75% concentrations of fresh cow milk ranged from 91.25% to 93.50%. Highest germination percentage value of 93.50% was recorded for seeds treated in 75% concentration of fresh cow milk. High concentration of fresh cow milk consists of adequate level of hormones required for seed germination, growth and development in plants. This result is contrary to the report of Naeem *et al*. (2004) and Gulluoglu, (2004) who stated that only hormones in low concentration regulates growth, differentiation and development, either by promotion or inhibition and also allows physiological processes to occur at their normal rate. Auxins may regulate cell elongation, tissue swelling, cell division, formation of adventitious roots, callus initiation and growth, induction of embryogenesis and promote cell wall loosening at very low concentration (Azad *et al.,* 2004; Woodward and Bartel, 2005; Muthukumar *et al.*, 2007; Abel and Theologis, 2010).

A significant increase in percentage germination was recorded with all the seed treatment time compared to control. The percentage germination value of seeds soaked in fresh cow milk ranged from 72.50% to 98.50% for the control (0) and 14hours treatment. The highest germination percentage value of 98.5% was recorded in seeds soaked for 14hours in fresh cow milk. This shows that long period of pre-sowing treatment influence the germination of seeds of the plants. This is consonance with the documentation of Adelani *et al.*(2014b) who reported that germination percentage value of *Balanites aegyptiaca* seeds hydroprimed for 14 hours (57.5%) was significantly ($P<0.05$) higher than those of 12 hours (48.85%); 8hours (44.45%); 6hours (45%) and 0 hour (18.75%).

Interactive effects of concentrations and treatment times of fresh cow milk on the germination of *T. indica* seeds.

The percentage germination value of seeds soaked in all concentrations of fresh cow milk for all treatment times ranged from 70% to 100%. A significant increase in percentage germination was recorded for all seeds treated in all concentrations of fresh cow milk and for treatment periods compared to control (Table 3). Hormones also speed the rate of germination in plant seeds. Major plant growth regulators (PGRs) significantly enhanced seed germination rate in black gram and horse gram (Chauhan *et al.,* 2009b), floral buds in *Jojoba* (Prat *et al.,* 2008) and other growth parameters in different plants. Gibberellic acid is responsible for stimulating the production of mRNA molecules in the cells and mRNA produced in this form, is for the hydrolytic enzymes, which in turn improves the chances of fast growth (Richards *et al.,* 2001; Sun, 2004). Growth regulators are proved to improve effective partitioning and translocation of accumulates from source to sink in the field crops (Solaimalai *et al.,* 2001; Senthil *et al.,* 2003).

Interactive effects of mean germination time of concentrations and treatment times of fresh cow milk on the germination of *T. indica* seeds

The result of interactive effects of mean germination time of concentrations and treatment times of fresh cow milk on the germination of *T. indica* seeds is presented in Table 4. The least value of 13.00 days was recorded in seeds not treated (control) in 50% concentration of fresh cow milk.

Table 2: Effect of fresh cow milk on the germination of *T. indica* seeds

Concentration of fresh cow milk (%)	Percentage germination (%)	MG T (Days)	Treatment time (Hours)	Percentage germination (%)	MGT (Days)
	------	------	0	72.50^{b}	13.63^{b}
25	91.50^{a}	18.70^{a}	6	95.63^{a}	20.00^{a}
50	92.00^{a}	18.60^{a}	8	96.88^{a}	20.00^{a}
75	93.50^{a}	18.80^{a}	12	98.13^{a}	20.00^{a}
100	92.50^{a}	18.80^{a}	14	98.75^{a}	20.00^{a}
SE+	1.59	0.21	SE+	1.78	0.24

*Means on the same column having different superscript are significantly different (P<0.05)

Table 3: Interactive effect of concentration and treatment time of fresh cow milk

Concentration of fresh cow milk(%)	Treatment time (Hours)				
	0	6	8	12	14
25	72.50^{b}	95.00^{a}	95.00^{a}	95.00^{a}	100.00^{a}
50	70.00^{b}	95.00^{a}	100.00^{a}	97.50^{a}	97.50^{a}
75	77.50^{b}	95.00^{a}	97.50^{a}	100.00^{a}	97.50^{a}
100	70.00^{b}	97.50^{a}	95.00^{a}	100.00^{a}	100.00^{a}
SE+	2.25	2.52	2.52	2.52	2.52

*Means on the same rows having different superscript are significantly different (P<0.05)

Table 4: Interactive effect of mean germination time of concentrations and treatment times of fresh cow milk on the germination of *T. indica*

Conc. of Cow Milk	Treatment Time (Hours)				
(%)	0	6	8	12	14
25	13.50^{b}	20.00^{a}	20.00^{a}	20.00^{a}	20.00^{a}
50	13.00^{b}	20.00^{a}	20.00^{a}	20.00^{a}	20.00^{a}
75	14.00^{b}	20.00^{a}	20.00^{a}	20.00^{a}	20.00^{a}
100	14.00^{b}	20.00^{a}	20.00^{a}	20.00^{a}	20.00^{a}
SE±	0.24	0.24	0.24	0.24	0.24

*Means on the same rows having different superscript are significantly different (P<0.05)

Effect of coconut milk on the germination of *T.indica* seeds

The result of effect of concentrations and treatment times on the germination of *T. indica* seeds is presented in Table 5. Significantly higher percentage germination was recorded in seeds treated in coconut milk for treatment time compared to control. Coconut milk in this experiment contained equal mixture of coconut water and extract from endosperm of coconut. It was observed in this study that coconut water (T3) significantly did better in terms of seedling growth and development when used as a pre germination treatment for *Tetrapleura tetraptera* seeds (Omokhua *et al.,* 2015). Coconut water contains a variety of nutrients including cytokinins that regulate growth and development of plants. The work of Shakeel (2010) also confirmed the influence of coconut water on plant seeds in his research on the effect of coconut water on callus growth of *Cyamopsis tetragonolobust* (Omokhua *et al.,* 2015.) The most effective method of breaking dormancy according to this study is by soaking in coconut water for 30 minutes which could be attributed to the fact that cytokinnins exert various roles in the different aspects of plant growth and development (Omokhua *et al.,* 2015). The plant growth hormones also increases mobilization of reserve food materials to the developing sink through increase in hydrolyzing and oxidizing enzyme activities and leads to yield increases (Jayachandran *et al.,* 2000). Plant hormones play a vital role in coordination of many growth and behavioral processes in the plant life (Tiwari *et al.,* 2011). Growth regulators are proved to improve effective partitioning and translocation of accumulates from source to sink in the field crops (Solaimalai *et al.,* 2001; Senthil *et al.,* 2003).

It has long been ascertained that plant hormones including auxins, gibberellins, cytokinin and ethylene etc., are involved in controlling developmental events such as cell division, cell elongation and protein synthesis (Tiwari *et al.,* 2011). Gibberellin (GA), auxin, and cytokinin are three classic plant hormones known to regulate plant growth and development (Bai and DeMason, 2008). Cytokinins play roles in the regulation of cell division, development of the shoot and root, delay of senescence, and transduction of nutritional signals (Bai and DeMason, 2008).

Plants have the ability to store excessive amounts of exogenously supplied hormones in the form of reversible conjugates which release active hormone when and where plant needs them during the growth period. Auxin is an essential hormone that also provides directional and positional information for plant growth and development (Bai and DeMason, 2008). Auxins may regulate cell elongation, tissue swelling, cell division, formation of adventitious roots, callus initiation and growth, induction of embryogenesis and promote cell wall loosening at very low concentration (Azad *et al.*, 2004; Woodward and Bartel, 2005; Muthukumar *et al.,* 2007; Abel and Theologis, 2010). Similarly, Gibberellins are plant hormones that participate in regulation of many growth and developmental processes in various plants (Hedden and Phillips, 2000; Olszewski *et al.,* 2002; Naeem *et al.*, 2001; Shah *et al.*, 2006; Shibairo *et al.*, 2006; Emongor, 2007). They are especially important in regulating stem elongation (Richards *et al.*, 2001; Itoh *et al.*, 2001; Spielmeyer *et al.,* 2002; Schomburg *et al.,* 2003; Sakamoto *et al.*, 2004; Sun, 2004). Gibberellic acid is responsible for stimulating the production of mRNA molecules in the cells and mRNA produced in this form, codes for the hydrolytic enzymes, which in turn improves the chances of fast growth (Richards *et al.,* 2001; Sun, 2004).

Remarkable increase in growth and yield characteristics with the exogenous application of Gibberellic acid, NAA and other growth hormones were also reported by earlier workers such as Kalavathi *et al.* (2000), Yogesha *et al.* (2000) and Thangaraj *et al.* (2000) in rice, Naeem *et al.* (2001) in tomato, Sarkar *et al.* (2002) in soybean, Muthukumar *et al.* (2007) in baby corn (*Zea mays* L.), Shibairo *et al.* (2006) in potato, Shah *et al.* (2006) in black cumin (*Nigella sativa* L.) and Emongor (2007) in cowpea. GA has long been recognized to play roles in seed germination, stem and petiole elongation, induction of flowering, fruit growth, and root development (Bai and DeMason, 2008).

Interactive effect of concentrations of coconut milk and treatment times on the germination of *T. indica* Seeds

The percentage germination value of seeds treated in all concentrations of coconut milk, for all treatment times ranged from 65% to 100% (Table 6). An increase in percentage germination was recorded with increasing number of hours the seeds were subjected to 25% concentration of coconut milk. Low concentration of coconut milk supplied the essential hormones at low level that induced higher germination. Previous studies have highlighted that the increase in concentrations of hormones on seeds of various tree species as *Acacia senegalensis* (Bello *et al.,* 2013) and *Ceiba pentandra and Terminalia uperba* (Agboola, 2002) do not increase the germination percentages.

Germination percentage value of 100% was recorded for seeds soaked in 50% concentration of coconut milk for 14hours. Timing of the application is essential (AGII, 2008). Appropriate time of pre-sowing treatment influences the number of plant seeds that germinates. Appropriate time of pre-sowing that influences germination percentage varies with species. Highest germination can be recorded as period of treatment increases or decreases in some species. *Acacia auriculiformis* seeds soaked in H_2SO_4 for 10 minutes, recorded the highest germination percentage of 96% followed by those seeds treated with H_2SO_4 for 5 minutes (92%) and the least among the sulphuric acid treatment was 76% (2 minutes) followed by control treatments (42%) (Olatunji *et al*., 2012). In the same vein, Aduradola and Shinkafi (2003) reported enhanced seed germination with increasing treatment time for *Tamarindus indica*. Moreover, germination percentages of *Adansonia digitata* seeds improved with increased period of soaking in the acid up to 3 hours (Adio *et al.,* 2006).

Furthermore, Al-Menaie *et al.* (2010) reported increase in seed germination of *Cassia siamea* and *Cassia roxburghii* followed their increased period of soaking in H_2SO_4 at 50^oC (72%) and 21^oC (28%) for up to 24 and 48 hours of daily observation for two months. The variations in appropriate time of pre-sowing for each species have been reported by various researchers. In this respect, Olmez (2011) indicated that the pretreatment by submersion in sulphuric acid for 1 minute should be used to overcome dormancy of the *Hippohae rhamnoides* seeds. Similarly, acid treatment at 98% concentration for *Adansonia digitata* seeds soaked for 1 hour showed significant effect on germination (Falemara *et al.,* 2013).

Interactive effect of mean germination time of concentrations and treatment times of coconut milk on the germination of *T. indica* seeds

The result of interactive effect of means germination time of concentrations and treatment times of coconut milk on the germination of *T. indica* seeds is presented in Table 7. The mean germination time value of seeds soaked in all concentrations of coconut milk for all treatment times ranged from 9% to 20%. An increase in treatment time increases the mean germination time. This is in consonance with the documentation of Afrasyab and Reza (2007) that reported a reduction in seed vigor index, germination rate and increased mean germination time by increasing immersion time in H_2SO_4.

Table 5: Effect of coconut milk on the germination of *T. indica* seeds

Conc. of coconut milk (%)	Percent germ(%)	MGT (Days)	Treat time(Hours)	Percent germ(%)	MGT (Days)
-	-		0	66.88^b	9.63^b
25	91.00^a	17.70^a	6	95.00^a	19.75^a
50	91.50^a	17.50^a	8	98.13^a	19.50^a
75	91.50^a	17.30^a	12	98.13^a	19.00^a
100	90.50^a	17.20^a	14	97.50^a	19.25^a
SE±	1.15	0.38	SE	1.28	0.43

*Means on the same column having different superscripts are significantly different ($P<0.05$)

Table 6: Interactive effect of concentrations of coconut milk and treatment times on the germination of T. indica Seeds.

	Treatment time (Hours)				
Conc of Coconut milk (%)	0	6	8	12	14
25	67.5^b	92.5^a	97.5^a	100^a	97.5^a
50	65.0^b	95.0^a	100^a	97.5^a	100^a
75	67.5^b	97.5^a	97.5^a	97.5^a	97.5^a
100	67.5^b	95.0^a	97.5^a	97.5^a	95.0^a
SE±	2.56	2.56	2.56	2.56	2.56

*Means on the same rows having different superscript are significantly different (P<0.05)

Table 7: Interactive effect of mean germination time of concentrations of coconut milk and treatment times on the germination of *T. indica* seeds

Conc. of Coconut Milk(%)	Treatment times (Hours) 0	6	8	12	14
25	10.00^{b}	20.00^{a}	19.50^{a}	19.50^{a}	19.50^{a}
50	9.00^{b}	20.00^{a}	20.00^{a}	19.50^{a}	19.00^{a}
75	9.50^{b}	19.50^{a}	19.00^{a}	19.00^{a}	19.50^{a}
100	10.00^{b}	19.50^{a}	19.50^{a}	18.00^{a}	19.00^{a}
SE$\pm$	0.43	0.43	0.43	0.43	0.43

*Means Means on the same rows having different superscript are significantly different (P<0.05)

Conclusion

This investigation conducted on the effects of fresh cow milk and coconut milk on the germination of *T.indica* revealed that the percentage germination value of seeds soaked in all concentrations of fresh cow milk for all hours of treatments ranged from 70% to 100%. The percentage germination ranged from 65% to 100% for all concentrations and treatment times of seeds treated in coconut milk. For highest germination percentage value to be obtained for agro-forestry programmes, *T. indica* seeds need to be treated for 14hours in 50% and 100% concentrations of coconut milk and fresh cow milk respectively.

References

Abel, S and Theologis, A (2010) *Odyssey of Auxin*. In Estelle M, Weijers D, Ljung K and Leyser O (eds.) *Perspective in Biology.* Cold Spring Harbor Press, Leibniz-Institut Fuer, Germany, p. 1-13.

Abubakar, Z. A and A. Muhammad. (2013). Breaking seed dormancy in tamarind *(Tamarindus indica).* A case study of Gombe Local Government Area. *Journal of Applied Sciences and Environmental Management 17* (1): 83-87

Adelani, D.O., Akande, M.T and Maikano, T (2014b). Effect of horticultural techniques on the growth of seed of desert date. *Horticulture for a Healthy and Wealthy Nation.* Paper presented *at the 32nd Annual Conference of Horticultural Society of Nigeria (HORTSON)* PP95.

Adelani, D.O.,Suleiman, R. A., Olaifa, R. K and Yohanna, E. A. (2014a). Hormonal pretreatments of African locust bean tree seeds (*Parkia biglobosa* Jacq benth). *Sudano-sahelian Landscape and Renewable Natural Resources Development in Nigeria. In:* O.Y. Ogunsanwo; A.O. Akinwole; I.O. Azeez; V.A.J. Adekunle and N.A .Adewole (eds); *Proceedings of the 37th Annual Conference of the Forestry Association of Nigeria,* Printed by Exotic Denzines ltd. pp337-346.

Adelani, D.O (2015). Effects of pre-germination treatments and sowing depths on early growth of sesban (*Sesbania sesban*). *Applied Tropical Agriculture* (1): 31-36.

Adelani, D.O and Maisamari I.J. (2016). Effect of fresh cow milk and coconut milk on the germination of baobab (*Adansonia digitata*) seeds. *Biological and Environmental Sciences Journal for the Tropics 8* (4):1-10.

Adio, A.F., G.A. Odigie and G. T. Imran .(2006). The influence of pre-treatments on germination of seeds of *Adansonia* *digitata* (Baobab). *Journal of Forestry Research and Management* 3:27-33.

Aduradola, A.M and Shinkafi, M.A. (2003). Aspects of seed treatment for germination in *Tamarindus indica* Linn. *Journal of Agriculture and Environment 33* (4): 29-34

Afrasyab, R.G. and Reza, T.A. (2007). Methods for dormancy breaking and germination of galbanum seeds (*Ferula gummosa*). *Asian Journal of Plant Sciences* 6 (4): 611-616.

Agboola, D.A. (2002). The effect of plant growth hormones and thiourea on seed germination of *Ceiba pentandra* and *Terminalia superba. Journal of Agriculture, Science and Environment* (1): 39-46.

Agri-Growth International Incorporation (2008) Nitrozyme**:** The Plant Growth Regulator For increased Quality and Marketable Yields. http://www.agriorganics.com PP 3.

Aliero, B. L. (2004). Effects of sulphuric acid, mechanical scarification and wet heat treatments on germination of seeds of African locust bean tree, *Parkia biglobosa African Journal of Biotechnology 3* (3): 179-181.

Al-Menaie, H.S., O. Al-Ragam., A. Al-shatti., M. Mattew and N. Suresu (2010). The effects of different treatments on seed germination of the *Cassia fistula* L and *Cassia nodosa* Buch-Ham. Ex Roxb. In Kuwait; *African Journal of Agricultural Research 5*(3): 230-235.

Aida, P., V. Rosa., F. Blamea., A. Tomas and C. Savador. (2001*).* Paraguyan plants used in traditional medicine. *Journal of Ethnopharmacology* 16: 93- 98.

Ajiboye, A.A., M.A. Atayese and D.A.Agboola. (2009). Effect of presowing treatments on seed germination and percentage starch contents levels in *Tamarindus indica*, *Prosopis africana*, *Parkia biglobosa* and *Albizia lebbeck. Nigerian Journal of Botany 22*(2):389-39

Ajiboye, A.A (2010). Dormancy and seed germination of *Tamarindus indica* (L). The *Pacific Journal of Science and Technology 11* (2): 463-470.

Akindele, S.O. (2004). *Basic Experimental Designs in Agricultural Research.* Printed by Royal Bird Venture, Mushin, Lagos, Nigeria, 190.

Azad, M.A.K., S. Yokota., S. Yahara and N. Yoshizawa. (2004). Effects of explant type and growth regulators on organogenesis in a medicinal tree, *Phellodendron amurense* Rupr. *Asian Journal of Plant Science* 3: 522-528.

Bai, F and D. A. DeMason (2008). Hormone interactions and regulation of *PSPK2 :: GUS* compared with *DR5::GUS* and *PID::GUS* in *ARABIDOPSIS THALIANA. American Journal of Botany 95*(2): 133–145.

Bello, A. G., Isah A. D., Audu, M and Igbokwe G. O (2013). Germination and growth of *Acacia senegal and Balanites aegyptiaca* in response to auxin (indole-3-acetic acid) in savannah area of Sokoto State, Nigeria. *In:* Labode Popoola, F.O.Idumah, O.Y.Ogunsanwo and I.O.Azeez (Eds). *Forest Industry in a Dynamic Global Environment. Proceedings of the 35th Annual Conference of the Forestry Association of Nigeria.* pp.30-36.

Chauhan J.S., Tomar Y.K., Singh N. I., Seema A and Debarati. (2009). Effect of growth hormones on seed germination and seedling growth of Black gram and Horse gram. *Journal of America Science 5*(5): 79 – 84.

Coutino-Rodriguez, R., Hernandez-Cruz, P and Gillis-Rios, H. (2001). Lectins in fruits having gastro-intestinal activity and their participation in the hemaglutinating property of *Escherichia coli* 0157. *Archives of Medical Research* 32:251-259.

Dewir, Y. H., M. E, El-Mahrouk and Y. Naidoo (2011). Effects of some mechanical and chemical treatments on seed germination of *Sabal palmetto* and *Thrinax morrisii* palms. *Australian Journal of Crop Science 5*(3):248-253.

Djamgoz, M and Jane, P.(2015). *10-Step Plan to help you Overcome and Prevent Cancer'* Vermilion publisher pp 9.

Ebofin, A. O., Agboola D.A.., Ayodele, M.S and Aduradola, A.M. (2003): Effect of some growth hormones on seed germination and seed seedling growth of some savannah tree legumes. *Nigerian Journal of Botany* 16： 64-75.

Emongor, V.(2007). Gibberellic acid (GA_3) influence on vegetative growth, nodulation and yield of cowpea (*Vigna unguiculata* (L.) walp. *Journal of Agronomy* 6: 509-517

Ehiagbonare, J.E and H.I. Onyibe. (2007). Effect of pre-sowing treatments on seed germination and seedling growth on *Tetracarpidium conophorun*. *African Journal of Biotechnology 6* (6): 697-698.

Falemara, B.C., Nwadike, C and E. O. Obashola. (2013). Germination response of baobab seeds (*Adansonia digitata* L) as influenced by three pre-treament techniques. *In*: Labode Popoola, F.O. Idumah; O.Y. Ogunsanwo and I.O. Azeez (Eds); *Forest Industry in a Dynamic Global Environment; Proceedings of the 35th Annual Conference of the Forestry Association of Nigeria*, pp44-45.

Ferrara, L. (2005). Antioxidant activity of *Tamarindus indica. Ingredient Alimentary* 4(6): 13-15.

Gehlot, M and P. K. Kasera (2012).Improvement of seed germination behaviour in *Phyllanthus amarus* by acid and mechanical scarification pretreatments. *Ecoprint* 19: 1-5.

Gomez, K.A and Gomez, A.A. (2010). *Statistical Procedures for Agricultural Research*, Second Edition, John Wiley and Sons, New York, United States of America. 680pp. 680pp.

Gulluoglu, L. (2004). Determination of usage of plant growth regulators in soybean (*Glycine max* Merr) farming under Harran plain conditions**.** *Journal of the Faculty of Agriculture* 8: 17-23.

Habib, Y., M, Nasiri and A, Tavili. (2015). Effect of different physicochemical treatments on seed dormancy of medicinal herbs (*Portulaca oleracea* L.). *Research Journal of Medicinal Plants* 9: 72-80.

Hedden, P. and A.L. Philips (2000). Gibberellin metabolism: New insight revealed by genes. *Trends in Plant Science* 5: 523-530 Itoh, H., T.M. Ueguchi, N. Sentoku, H. Kitano, M. Matsuoka and M. Kobayashi, (2001).

Cloning and functional analysis of two gibberellin 3-hydroxylase genes that are differently expressed during the growth of rice. *Proceedings of the National Academy of Sciences of the United* 98: 8909-8914

Jayachandran, M., N.O. Gopal and R. Marimuthu (2000). Performance of hybrid rice cultures under different levels of nitrogen in combination with growth regulators. *The Madras Agricultural Journal* 89: 462-465.

Kalavathi, O., A. Ananthakalaiselvi and J. Vijaya (2000). Econonomization of GA_3 use in hybrid rice seed production by supplementing with other nutrients. *Seed Research* 28: 10-12.

Lewis, G.B., B. Schrire., Mackinder, B and Lock, M. (2005). *Legumes of the World.* Royal Botanical Gardens, Kew. 577 pp.

Martinello, F., Soares, S.M., Franco,J.J., Santos, A.C., Sugohara, A., Garcia, S.B., Curti, C and Uyemura, S.A. (2006). Hypolipemic and antioxidant activities from *Tamarindus indica* L; pulp fruit extract in hypercholesterolemic hamsters. *Food and Chemical Toxicology* 44(6):810-818.

Morton, J.G (1987). *Fruits of warm Climates.* Florida Flair Books, Miami. 505pp.

Muthukumar, V.B., K. Velayudham and N. Thavaprakaash. (2007). Plant growth regulators and split application of nitrogen improves the quality parameters and green cob yield of baby corn (*Zea mays* L.). *Journal of Agronomy, 6*: 208-211.

Naeem, N., M. Ishtiaq., P. Khan., N. Mohammad., J. Khan and B. Jamiher (2001). Effect of gibberellic acid on growth and yield of tomato Cv. Roma. *Journal of Biological Sciences* 1: 448-450.

Naeem, M., Bhatti, I., Ahmad, R.H and Ashraf, M.Y. (2004). Effect of some growth hormones (GA_3, IAA and Kinetin) on the morphology and early or delayed initiation of bud of lentil (*Lens culinaris* Medik). *Pakistan Journal of Botany* 36: 801-809.

Omokhua, G. E., Aigbe, H.I and Ndulue, N. B. (2015). Effects of pre germination treatments on the germination and early seedling growth of *Tetrapleura tetraptera* (Schum. & Thonn.*). International Journal of Scientific and Technology Research 4* (3): 160-164.

Olatunji, D; Maku, J.O and Odumefun, O.P. (2012). Effect of pre-treatments on the germination and early seedling growth of Acacia auriculiformis Cunn.Ex.Benth. African Journal of Plant Science 6 (14): 364-369.

Olmez, Z. (2011). Effects of cold stratification and H_2S0_4 on seed germination of sea buckthorn (*Hippophae rhamnoides* L). *African Journal of Biotechnology, 10* (22):4586-4590.

Olszewski, N., T. Sun and F. Gubler (2002). Gibberellins signaling: Biosynthesis, catabolism and response pathways. *Plant Cell* 14: 61-80

Otegbeye, G.O., Owonubi, J.J and Oviasauyi, P.K (2001). Interspecific variation growth of *Eucalyptus* growing in northern Nigeria. *In*: Popoola, L, Abu J.E and Oni, P.I *(Eds). Proceedings of 27^th^ Annual Conference of the Forestry Association of Nigeria* pp 12 – 16.

Prat, L., Batti, C and Fichet, T. (2008). Effect of plant growth regulators on floral differentiation and seed production in jojoba (*Simmondsia chinesis* (Link) Schneider*). Industrial Crops and Products* 27: 44-49.

Rastogi, A., Siddiqui, A., Mishra, B. K., Srivastava, M., Pandey, R.., Misra, P., Singh, M and Shukla, S. (2013) Effect of auxin and gibberellic acid on growth and yield components of linseed (*Linum usitatissimum* L.). *Crop Breeding and Applied Biotechnology* 13(2): 1-10.

Rajkumar, M., Uttam, K. D and Debidas, G. (2005).Attenuation of hyperglycemia and hyperlipi-demia instreptozotocin induced diabetic rats by aqueous extract of seed of *Tamarindus indica. Biological and Pharmaceutical Bulletin* 28:1172–1176.

Richards, D.E., K.E. King., A.T. Ali and N.P. Harberd, (2001). How gibberellin regulates plant growth and development: A molecular genetic analysis of gibberellin signaling. *Annual Review of*

Plant Physiology and Plant Molecular Biology 52: 67-88.

Sananse, S. L and Maidapwad, S.L. (2014). On analysis of two-way ANOVA using data transformation techniques. *International Journal of Scientific Research 3*(11): 480-483.

Samina K.K., Shaikh, W., Shahzadi, S., Kazi, T.G., Usmanghani, K and Kabir, A. (2008). Chemical constituents of *Tamarindus indica*. Medicinal plant in Sindh. *Pakistan Journal of Botany* 40: 2553–2559.

Sarkar, P.K., M.S. Haque and M.A. Karim (2002). Effects of GA3 and IAA and their frequency of application on morphology, yield contributing characters and yield of soybean. *Journal of Agronomy* 1: 119-122.

SAS (2003). *Statistical analysis system*. SAS release 9. 1 for windows, SAS Institute Inc. cary, NC, USA.

Schelin, M., Tigabu, M., Eriksson, I. and Sawadogo, L. (2003). Effect of scarification, gibberellic acid and dry heat treatments on the germination of *Balanties aegyptica* seeds from the Sudanian savanna in Burkina Faso. *Seed Science and Technology.* 31:605-617.

Schmidt, L. (2000). *Guide to Handing of Tropical and Subropical Forest Seed.* Danida Forest Seed Centre. Humle back, Denmark pp303.

Schomburg, F.M., C.M. Bizzell, D.J. Lee, J.A. Zeevaart and R.M. Amasino (2003). Overexpression of a novel class of gibberellin 2-oxidases decreases gibberellin levels and creates dwarf plants. *Plant Cell* 15: 151-163.

Senthil, A., M.. Djanaguiraman and R. Chandrababu. (2003). Effect of root dipping of seedlings with plant growth regulators and chemicals on yield and yield components of rice (*Oryza sativa* L.) transplanted by broadcast method. *Madras Agricultural Journal* 90: 383-384.

Shah, S.H., I. Ahmad and Samiullah (2006). Effect of gibberellic acid spray on growth, nutrient uptake and yield attributes during various growth stages of black cumin (*Nigella sativa* L.). *Asian Journal of Plant Sciences* 5: 881-884.

Shakeel .A (2010): Effect of coconut water on callus growth of *Cyamopsis tetragonolo bust. Australian Journal of Botany 58(7):*539-545.

Shibairo, S.I., P. Demo, J.N. Kabira, P. Gildemacher ., E. Gachango., M.Menza., R.O. Nyankanga., G.N.Chemining'wa and R.D. Narla (2006). Effects of gibberellic acid (GA3) on sprouting and quality of potato seed tubers in diffused light and pit storage conditions. *Journal of Biological Sciences* 6: 723-733

Spielmeyer, W., M.H. Ellis and P.M. Chandler (2002). Semidwarf (sd-1), Green Revolution Rice, Contains a Defective Gibberellin 20-oxidase Gene. *Proceedings of `the National Academy of Sciences of the United States* 99: 9043-9048.

Sakamoto, T., Miura, K., Itoh , H., Tatsumi, T., Ueguchi-Tanaka, M., Ishiyama, K., Kobayashi, M., Agrawal, G.K., Takeda, S., Abe, K., Miyao, A., Hirochika, H., Kitano, H., Ashikari, M and Matsuoka, M. (2004). An overview of gibberellin metabolism enzyme genes and their related mutants in rice. *Plant Physiology* 134:1642-1653.

Solaimalai, A., C. Sivakumar., S. Anbumani., T. Suresh and K. Arumugam, (2001). Role of plant growth regulators in rice production: A review. *Agricultural Revolution* 22: 33-40.

Sun, T. (2004). Gibberellin Signal Transduction in Stem Elongation and Leaf Growth. In: *Plant Hormones; Biosynthesis, Signal Transduction, Action*, Davies, P.J. (Ed.). Kluwer Academic Publication, Dordrecht, The Netherlands, pp: 304-320.

Thangaraj, M., M. Laxmiprabha and D.D. Devi (2000). Physiological and biochemical effects of barassonalides on productivity of rice. *Oryza,* 87: 49-50.

Tiwari, D.K.., P. Pandey, S.P. Giri and J.L. Dwivedi (2011). Effect of GA_3 and other plant growth regulators on hybrid rice seed production. *Asian Journal of Plant Sciences* 10*:* 133-139.

Vwioko, E.D and Longe, M.U (2009) Auxin and gibberellin effects on growth and fruit size in *Lagenaria siceraria* (Molina standley). *Bioscience Research Communications* 21: 263-271.

Warda, S., Abdel, G., Fathia, M and Amel O. B (2007). Antibacterial activity of *Tamarindus indica* fruit and *Piper nigrum* seed. *Research Journal of Microbiology* 2: 824-830.

Woodward, A.W. and B. Bartel, (2005). Auxin: Regulation, action and interaction. *Annals of Botany* 95: 707-735.

Yogesha, H.S., S. Pandey and S.P. Sharma (2000). GA_3 to obtain synchrony in hybrid seed production. *Seed Research* 28: 87-89.