American-Eurasian J. Agric. & Environ. Sci., 16 (7): 1378-1382, 2016
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2016.16.7.12968

Effect of Plant Growth Hormones and Chemicals on Germination Rate and Growth of *Arenga pinnata* Seeds

Noorshilawati Abdul Aziz and Nur Suraya Abdullah

Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA Pahang,
26400 Bandar Tun Abdul Razak Jengka, Pahang, Malaysia

Abstract: Sugar palm (*Arenga pinnata*) is classified as one of the multipurpose tree species. Palm sap widely used in the production of sugar, wine and vinegar, while palm fruits typically used as deserts and produce juices. Other parts such as fibres can be used in manufacturing of brooms, ropes, filters and roof and sugar palm also had been proved can produce bioethanol after passed through fermentation process. *Arenga pinnata,* however, faced dormancy problem which restricted the commercialization and the production in large scale. The seed contain a hard black seed coat and the germination is unpredictable. Commonly, it takes about 4 to 20 months for *Arenga pinnata* to germinate. Thus, the study was conducted to evaluate the germination rate and growth performance of *Arenga pinnata* after treated with hormone and chemical treatments. Gibberellic acid at three different concentrations, 150, 160 and 170 ppm were prepared as plant hormone treatments. While, hydrochloric acid (HCl), nitric acid (HNO_3) and sulphuric acid (H_2SO_4) at concentration 0.3, 0.4 and 0.5% were used as chemical treatments. Seeds soaked in distilled water posed as control treatment. The results of the study indicated that hormone and chemicals application on *Arenga pinnata* seed gives significant difference on the germination rate and plant growth. Percentage of germination particularly more than 50% for all seeds treated with gibberelic acid (76.67%, 80%, 83.33% respectively) and 21.67% for control. It is shown that the germination rate is increase as the concentration of gibberellic acid increased. Seed treated with 170 ppm gibberelic acid shows the best growth for the length of plant (38.6 cm), length of radical (17.4 cm) and length of plumule (21.2 cm). As for chemical treatments, 100% of seeds were germinated after treated with 0.4% HCl. Meanwhile, 90% germination rate was recorded for 0.3% HNO_3 treatment and 56.7% germination rate were recorded for 0.5% H_2SO_4 treatment. The lowest germination rate for all chemical treatments was recorded in 0.3% H_2SO_4 treatment which is only 43.3%. In HCl treatment, no significant difference recorded for each parameters (plant length, plant radical and plant plumule) treated with different concentration. In HNO_3 treatment, 0.3% concentration shows the highest plant length (30cm), 0.5% concentration shows the highest radical length (14.4cm) and 0.3% concentration shows the highest plumule length (17cm). H_2SO_4 treatment indicated that at 0.4% concentration, the highest plant, radical and plumule lengths are recorded. The length of plant, length of radical and length of plumule for all seeds treated with different chemical treatment shows significant different when compared with control treatment. The results revealed that suitable hormone and acid treatment can promote the germination rate and plant growth of *Arenga pinnata*. Treatments to accelerate the germination rate and growth of *Arenga pinnata* should be encouraged as *Arenga pinnata* can promote green technology.

Key words: *Arenga pinnata* · Sugar palm · Dormancy breakdown · Gibberelic acid · Chemical treatment

INTRODUCTION

Sugar palm or scientifically known as *Arenga pinnata* is native in Southeast Asia and widely distributed in other country such as Vietnam, Laos and Cambodia [1, 2]. In Malaysia, sugar palm can be found in Kuala Pilah in Negeri Sembilan, Jasin in Melaka, Bruas and Parit in Perak and Raub in Pahang [3]. Previous study reported that all parts of sugar palm such as leaves, trunk, fruit and bark can be utilized [1] to produce variety of

Corresponding Author: Noorshilawati Abdul Aziz, Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA Pahang, 26400 Bandar Tun Abdul Razak Jengka, Pahang, Malaysia.

products such as ropes, filters, brooms and roof materials [3]. Sugar palm also can be used to make neera sugar, vinegar, food sources and timber [4]. The neera of sugar palm can be fermented to produce bioethanol which is used as a raw material in production of varieties of chemical products, solvents, pharmaceutical, alcoholic beverages and medicines [5]. The usage of this plant not only limited for consumable product but it is able to conserve the soil in term of prevent soil from erosion, improve soil macro conditions, improve soil porosity and trapping rainwater [6].

Sugar palm have a long youth phase before start producing flowering. Direct sowing is possible but the seed may take a long time to establish well [7]. Sugar palm seed usually dormant and it takes more than one year to germinate [1]. Dormancy of sugar palm seed is due to its hard seed coat which restricted the absorption of water. But, the problem or seed coat dormancy can be overcome through various mechanical, chemical and physical treatments [8]. Pre-treatment such as rub the outer seed on rough surface, soaked in hot water and chemical solution are among the process to increase seed germination [9]. Plant growth regulator such as gibberellic acid, kinetin and auxin also has been used to promote cell division and cell differentiation [6]. Previous study reported that gibberellic acid at concentration 150 ppm can increase germination of sugar palm seed up to 65% [8]. Chemical such as hydrochloric acid (HCl), sulphuric acid (H_2SO_4) and sodium hydroxide (NaOH) also have been used to breakdown seed dormancy and fasten germination time [10].

Although sugar palm tree seems to be productive, the plantation of this tree is still not well established. In addition, the germination of the sugar palm seed is unpredictable and these caused farmers refuse to plant the tree in large scale. Furthermore, report on the period of seed germination is also variable. Thus, this study was conducted to determine germination rate and growth of sugar palm seeds towards different hormone concentrations and various chemical treatments.

MATERIALS AND METHODS

Seeds and Medium Planting Preparation: Mature fruits of *Arenga pinnata* (Fig. 1a) were collected from Kg. Peruang, Benta, Kuala Lipis, Pahang, Malaysia. The study was conducted in the greenhouse of Universiti Teknologi MARA Pahang. Fruits of sugar palm were washed under running tap water to remove any dirt and then dried. Then, fruits were cut to obtain seeds which used for

(a) (b)

Fig. 1: (a) *Arenga pinnata* fruits and (b) sand medium

Table 1: GA_3 treatment at different concentrations

Treatment	Pre-treatment	Concentration (ppm)
Control	75°C / 15mins	0
GA_3	75°C / 15mins	150
	75°C / 15mins	160
	75°C / 15mins	170

experiment. In this experiment, sand was used as planting medium (Fig. 1b) and filled in polybag with size 6 inches (width) × 12 inches (height). Medium planting such as sand was proved as the best medium for seed germination [11].

Preparation and Application of Hormone Treatment: Gibberelic acid (GA_3) at different concentrations were used as hormone treatment. Stock solution of GA_3 with 1000ppm was prepared by dissolved one miligram of GA_3 in 1000 mL distilled water. Then, hormone treatment at concentration 0, 150, 160 and 170 ppm was prepared by dilution of stock solution. Before soaked in GA_3, seeds of sugar palm was pre-soaked in distilled water at temperature 75°C for 15 minutes. Then, seeds were soaked in different concentrations of GA_3 for 24 hours and then were directly sown in polybag [8]. The experiment was replicated ten times. Seed soaked in hot water without treated with hormone serve as control treatment (Table 1).

Preparation and Application of Chemicals Treatment: Three types of chemical treatment consist of hydrochloric acid (HCl), nitric acid (HNO_3) and hydrochloric acid (H_2SO_4) were prepared at concentration 0, 0.3, 0.4 and 0.5% by dilution with distilled water. For control treatment, seeds were soaked in distilled water for seven days while for chemical treatment, seeds were soaked in each chemical concentration for 30 minutes [12] and then directly sown in planting medium (Table 2).

Table 2: Chemicals treatments at different concentrations

Treatment	Concentration (%)	Soaking time
Control	Distilled water	7 days
HCL	0.3	24 hrs
	0.4	24 hrs
	0.5	24 hrs
HNO_3	0.3	24 hrs
	0.4	24 hrs
	0.5	24 hrs
H_2SO_4	0.3	24 hrs
	0.4	24 hrs
	0.5	24 hrs

Parameter Measurement and Statistical Analysis: Data consists of percentage of seed germination, length of plumule, length of radical and length of plant were recorded after three months. Data analyses were subjected to analysis of variance (ANOVA) using SPSS software. The Least Significant Different (LSD) test at $P < 0.05$ was used for mean comparison.

RESULTS AND DISCUSSION

Effect of GA_3 Concentrations on Percentage of Germination and Growth of *Arenga Pinnata* Seeds The results of the study show that percentage germination of *Arenga pinnata* seeds can be increased with increasing GA_3 concentrations. As compared to control treatment, seed soaked in the highest GA_3 treatment (170 ppm) gives the highest germination by 83.33%, compared with other treatments (Fig. 2). The highest plant length was recorded in 170 ppm GA_3 (38.6 cm), followed by 150 ppm GA_3 (35.5 cm), 160 ppm GA_3 (34.1 cm). The highest root length is recorded for the treatment non-scar 170 ppm gibberellic acid (17.4 cm). The effects of elongation were corresponding to the length of plumule where the highest value is recorded (21.2 cm) at 170 ppm GA_3 concentration. While, the lowest plumule length is 14.9 cm at 150 ppm GA_3 treatment. Sugar palm seed soaked in 150 ppm GA_3 has been reported promotes seed germination up to 65% [8].

The study is concordance with a study of….. [13] which reported that application of gibberellin can promote stem and shoot by increase both cell division seed germination and promote the radicle elongation and mobilization of endosperm during early stages of plant growth. The usage of gibberellic acid can increase the germination of seeds. GA_3 are the most effective treatment to break seed dormancy of seed *O.arabicus* for (80%-89%) at concentration 100µM GA_3 [14].

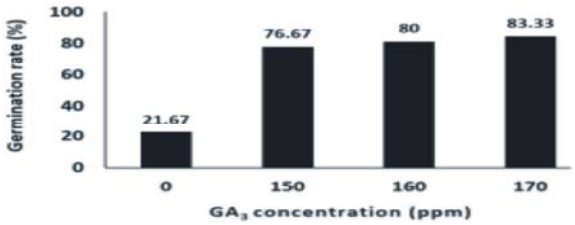

Fig. 2: Percentage germination of *Arenga pinnata* at different concentrations of GA_3

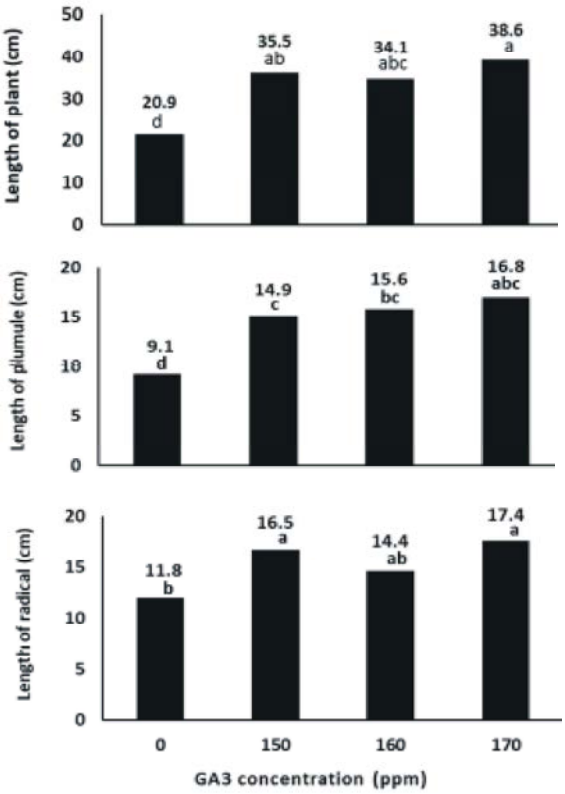

Fig. 3: Length of plant, plumule and radical of *Arenga pinnata* at different concentrations of GA_3

Effect of HCl, HNO_3 and H_2SO_4 Concentrations on Percentage of Germination and Growth of *Arenga Pinnata* Seeds: The results of the study indicated that percentage of seeds germination are higher in all chemical treatments as compared to control treatment. Treatment 0.4% HCl shows highest percentage of germination (100%) compared to other chemicals concentrations which is 63.3% and 50% in HNO_3 and H_2SO_4 respectively. The lowest percentage of seed germination was in control treatments which is 16.7%. Seed treated with chemical shows best performance in respect of seed germination and seedling vigour [15]. All concentrated sulfuric acid treatments tested enhanced the germination rate as compared to control treatment [16].

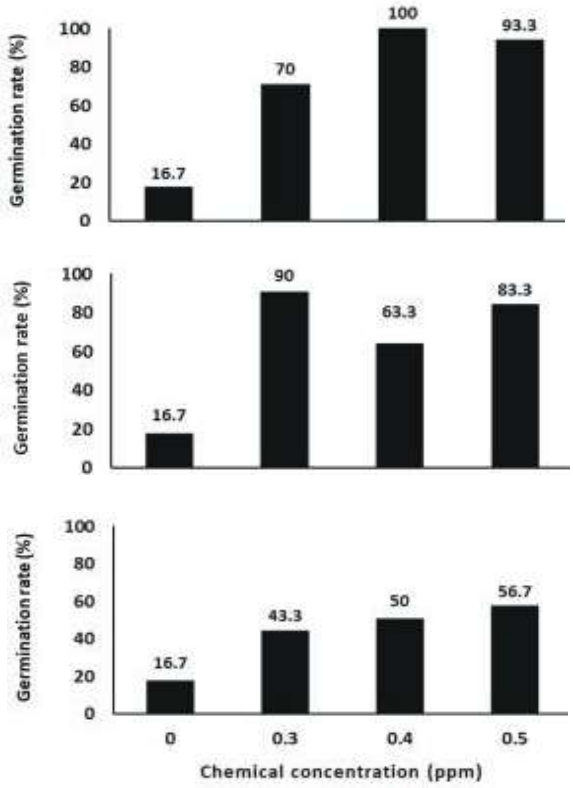

Fig. 4: Percentage germination of *Arenga pinnata* in (a) HCl, (b) HNO_3 and (c) H_2SO_4 at different concentrations

Table 3: Plant length (PLL), plumule length (PML) and radicle length (RL) of chemicals treatments at different concentrations

Treatment	Conc. (%)	PLL (cm)	PML (cm)	RL (cm)
Control	0	12.2±1.59 c	6.94±0.86 c	5.26±0.87 b
HCL	0.3	25.40±1.22 ab	12.72±1.18 b	12.68±0.58 a
	0.4	27.90±1.08 ab	15.26±0.83 ab	12.64±1.42 a
	0.5	24.90±2.04 ab	12.20±1.23 b	12.70±0.92 a
HNO_3	0.3	30.04±0.57 a	17.00±0.84 a	13.04±1.36 a
	0.4	25.40±0.87 ab	12.02±0.57 b	13.38±0.69 a
	0.5	28.20±1.31 ab	13.80±0.58 ab	14.40±1.34 a
H_2SO_4	0.3	24.50±2.24 b	12.14±1.00 b	12.36±1.77 a
	0.4	27.10±0.64 ab	13.76±0.59 ab	13.34±0.45 a
	0.5	23.04±2.19 b	12.30±1.02 b	10.74±1.35 a

The results of the study indicated that all chemical treatments shows significant difference compared to control treatment. The highest plant length and plumule length in HCL was about 27.9 and 15.26 cm respectively at concentration 0.4% while in HNO_3 treatment, highest plant length and highest plumule length were about 30.04 and 17.00 cm in lowest concentration (0.3%). Plant length and plumule concentration also highest in 0.4% HNO_3 concentration. For radicle length, all chemical concentrations shows significant difference as compared to control treatment. A study had indicate that acid scarification will enhance radicle length of plant [17]. The application of sulphuric acid as acid scarification will desirably promote seed germination rates as well as seedling growth [18].

CONCLUSION

The study revealed that among three types of chemical treatments, HCl shows the best performance in promoting seed germination, plant length, radicle and plumule length. It is in line with the finding by Desy *et. al.* [19] which found that the fastest germination time is present in HCl treatment. The finding of the study can contribute some knowledge to farmers in order to plant sugar palm in a large scale which later might increase their economic level. In addition, due to the important of sugar palm as renewable energy, it is important to investigate its growth pattern so that enough sources can be produce to support the technology of green energy as well as beneficial from its multipurpose used.

ACKNOWLEDGEMENT

The authors would like to thank the Ministry of Science, Technology and Innovation, Malaysia (MOSTI) for the research grant, Fundamental Research Grant Scheme (FRGS), 600-RMI/FRGS 5/3 (42/2013) for this research.

REFERENCES

1. Wolter, E. and O. Lee, 2010. Sugar palm (*Arenga pinnata*): Potential of Sugar Palm for Bio-Ethanol Production, Netherland: FACT Foundation, pp: 9.
2. Endri, M., R. James and W. David, 2011. Sugar Palm Ethanol: Analysis of Economic Feasibility and Sustainability, ECOFYS, Netherland, pp: 66.
3. Sahari, J., S.M. Sapuan, E.S. Zainudin and M.A. Maluque, 2012. Sugar Palm Tree: A Versatile Plant and Novel Source for Biofibers, Biomatrices and Biocomposites, Polymers from Renewable Resources, 3(2): 61-77.
4. Helen, B.F. and Priscilla, B. de M., 2003. Sugar Palm (*Arenga pinnata* (Wurmb.) Merr.), Research Information Series on Ecosystem, 15(2): 1-6.
5. Ishak, M.R., S.M. Sapuan, Z. Leman, M.Z.A. Rahman, U.M.K. Anwar and J.P. Siregar, 2013. Sugar palm (*Arenga pinnata*): Its fibres, polymers and composites, Carbohydrate 8 Polymers, 91(2): 699-710.

6. Micha, G.D., P. Agus and H. Ali, 2014. Globular Embryo Induction of Sugar Palm (Arenga pinnata (Wurmb) Merr.), International Journal of Bioscience, Biochemistry and Bioinformatics, 4(1): 60-66.
7. Van Dam, J.E.G., 2007. Validation *Arenga* palm sugar production, WUR-Agrotechnology and Food.
8. Oktoviani, P., Indriyanto and B. Afif, 2014. Germination of Sugar Palm (*Arenga pinnata*) Seed after Scarification with Giberellin on Various Concentration, Journal Sylva Lestari, 2(2): 71-78.
9. Hafizah, N., 2013. Fracturing Dormansy of Sugar Palm Seed (Arenga pinnata Merr) With The Seed Grindace and Various Sour Concentration of Sulphate Acid, Media Sains, 6(2).
10. Alebrahim, M.T., E. Kazerooni and R. Majd, 2009. The effect of some treatments on breaking seed dormancy in Mesquite, Ferdowsi University of Mashhad.
11. Ndor, E., N.S. Dauda and H.B. Chammang, 2012. Effect of germination media and seed size on germination and seedling vigour of fluted pumpkin (Telferia occidentalis) Hook. F., International Journal of Agricultural Sciences, 2(3): 113- 115.
12. Alan, W.M., 2014. Palm Seed Germination, University of Florida, pp: 2-11.
13. Nabil, M., A. Ameen and Al-Imam, 2007. Effect Of Soaking Periods, Gibberellic Acid and Benzyladenine On Pistachio Seeds Germination And Subsequent Seedling Growth (Pistacia vera L.), Mesoptamia Journal of Agric., 35(2).
14. Nadeem, M., A. Fahad, K. Salim, M. Tarroum and M. Ashraf, 2012. Effect Of Some Chemical Treatments On Seed Germination and Dormancy Breaking In An Important Medicinal Plant Ochradenus Arabicus Chaudhary, Hill C. & A.G.Mill, Pak. J. Bot, 44(3): 1037-1040.
15. Kumar, R., K.K. Misra, D.S. Misra and M. Brijwal, 2012. Seed germination of fruit crops. A review, HortFlora Research Spectrum, 1(3): 199-207.
16. Sedigheh, S., Y.A. Zoheir, M.F. Tabatabai and M.A. Hassan, 2009. Study Methods of Dormancy Breaking and Germination of Common Madder (Rubia tinctorum L.) Seed in laboratory conditions, Botany Research International, 2(1): 7-10.
17. Afshar, F.I., S.S. Ali and S. Mozhgan, 2014. Effect of H_2SO_4 on Seed Germination and Viability of Canna indica L. Ornamental Plant, International Journal of Advanced Biological and Biomedical Research, 2(1): 223-229.
18. Mitra, M., R.L.M. Ali and O.A. Zahra, 2013. The induction of seed germination using sulphuric acid, gibberellic acid and hot water in Robinia pseudoacacia L., International Research Journal of Applied and Basic Sciences, 4(1): 96-98.
19. Desy, M., A.P.P. Lollie and K.B. Mbue, 2013. Pengaruh Perlakuan Pematahan Dormansi Terhadap Viabilitas Benih Aren (Arenga pinnata Merr.), Jurnal Online Agroekoteknologi, 1(3): 768-782.