Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2020; SP6: 161-166

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International Web-Conference
On
New Trends in Agriculture, Environmental & Biological Sciences for Inclusive Development
(21-22 June, 2020)

Effect of husking (Removing Seed Tip) and Pre-Soaking treatments on seed germination and seedling growth of Mango Cv. Alphonso

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Abstract
A field experiment was carried out at College nursery, N. M. College of Agriculture, Navsari Agricultural University, Navsari during 2015-2016 to study the effect of husking (removing seed tip) and pre-soaking treatments on germination and seedling growth of mango cv. Alphonso. The experiment was laid out in completely randomized design (CRD) with factorial concept. The results revealed that unhusked seed soaked in cow dung slurry, KNO_3 @ 1%, KCL @ 1% and sucrose solution @ 1% proved to be the best with respect to germination % and survival %. When the husked seed (removing seed tip) dipped in KH_2PO_4 @ 1% and sucrose solution @ 1% observed maximum germination % and survival %. While, H_1P_1 (husked mango seed dipped in water) treatment reported minimum days taken for germination (10.15 days), optimum height of plant (61.80 cm) and maximum number of leaves (21.80) at 6 MAS. The seedling diameter was maximum in treatment H_1P_5 (husked mango seed dipped in 1 % KCL) at 6 MAS.

Keywords: Mango, Husking, Seed tip cutting, Pre-soaking, Seedling growth, Alphonso

Introduction
Mango (*Mangifera indica* L.) is the most tempting and popular fruit in our country. It can be propagated by seed as well as by vegetative or asexual means. Asexual propagation is preferred to obtain uniform and standard quality crop. Mature mango seeds have high moisture content, estimated to be in the range of 30 - 70% at maturity (Snageetha and Mani, 2014) [8] and cannot withstand desiccation *i.e.,* recalcitrant or desiccation-sensitive seeds. The seeds quickly lose viability in storage; hence, these are traditionally propagated by vegetative methods. For raising rootstocks, seeds are used to obtain seedling on which the desired varieties (scion) can be grafted. For the improvement in germination of mango seed some research has been summarized as under; Germination percentage of mango seeds was improved by husking or removing the hard seed coat (Abdel- Galil, 2002) [1]. Soaking seeds before sowing is reported to shorten the lag phase in germination and enhance seedling establishment thereby minimizing the risk in the early vegetative growth. The significantly enhancement of germination was noticed in different pre-soaking treatments (Padma and Narayana Reddy, 1998; Venkat Rao, 2002 and Venkata *et al.,* 2006 [6, 9, 10] in mango. Husking of mango seeds and soaking them in sucrose prior to sowing improved germination and seedling growth (Snageetha and Mani 2014) [8]. With the above findings, the present investigation was carried out to study the effect of husking (removing seed tip) and pre-soaking treatments on seed germination and seedling growth of mango cv. Alphonso.

Materials and Methods
The present investigation was carried out on mango seed cv. Alphonso at College Nursery, N. M. College of Agriculture, Navsari Agricultural University, Navsari during the month of July 2015-2016. The mango stones were washed thoroughly and the seed tip was removed by using the sharp knife and secateur.

The seeds were dipped in water and the floating seeds were discarded and only those seed which settled down at bottom were selected for this study. The experiment was laid out in a CRD factorial concept. There were total eighteen treatments consisting two factors *viz.*, Husking of seed H [H_0- unhusked seed (intact seed) and H_1- husked seed (removing seed tip)] and pre-soaking treatments P [P_0 (control- seed as such), P_1 (seed soaking in water), P_2 (seed soaking in cow dung slurry), P_3 (seed soaking in KNO_3 @ 1%), P_4 (seed soaking in KH_2PO_4 @ 1%), P_5 (seed soaking in KCL @ 1%), P_6 (seed soaking in sucrose @ 1%), P_7 (seed soaking in banana sap @ 2%) and P_8 (seed soaking in GA_3 @ 100ppm)]. Each treatment was comprised three replicates each of 20 seeds. Seeds of each treatment were immediately sown in black polyethylene bags containing a mixture of Soil: FYM: Vermicompost (2:1:1). Regular water and plant protection measures were taken as and when required. The observations were recorded daily for germination parameters and monthly for vegetative parameters *i.e.*, seedling height, seedling diameter and number of leaves per seedling were recorded at two month interval up to six month after sowing (MAS). The germination (%) was calculated by the following equation.

$$\text{Germination (\%)} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds}} \text{ X } 100$$

All of the data were statistically analyzed according to Panse and Sukhatme, 1985 [7].

Result and Discussion

With respect to the husking tretament, maximum germination and survival % was recorded in husked seed (removing seed tip) treatment, while minimum germination % and survival % was found in unhusked seed (intact seed). It may be due to the seed coat prevent germination as it interferes with water uptake and gaseous exchange and also contains chemical inhibitors which act as the barrier against the escape of inhibitors from the embryo which modifies the light reaching to the embryo and imposes mechanical restraint (Bewley and Black, 1983; Padma and Reddy, 1998) [2, 6]. The minimum days taken for germination (13.33 days) in Alphonso variety was noted in husked seed as compared to unhusked seed (23.08 days). The early germination in Alphonso fruit may be due to increased weight of stone as the stone weight was more the endosperm weight would have been more which might have supplied all of the necessary nutrients and hormones for faster germination of seedlings. The maximum seedling diameter and maximum number of leaves were observed in treatment H_1 (husked seed). This may be related to removing hard seed tip which enhance plant growth resulted in increasing the growth parameters (Muralidhara *et al.*, 2016) [5]. Whereas, maximum seedling height was noted in H_0 (intact seed) and minimum in H_1 (husked seed) treatment.

In case of pre-soaking treatments, mango seed soaked in sucrose solution noted highest germination % and survival % because positive effect of seed soaking in sucrose on the seed germination might be due to supply of readily available carbohydrates for respiration (Bewley and Black, 1983) [2] whereas germination % and survival % was found lowest in P_1 (seed soaked in water) treatment. At 2 MAS and 4 MAS (month after sowing) the P_2 treatment had the highest seedling height which was at par with P_5 whereas at 6th MAS P_6 treatment was recorded maximum seedling height. The role of sucrose is a major form in which the products of carbohydrates catabolism are translocated into developing seedlings (Esau, 1977) [3]. The present findings are also inconsistent with the result of Mabundza *et al.* (2010) [4] who reported that use of sucrose solution as a priming agent resulted in increased number of leaves and length of seedling roots and other growth parameters. The minimum days taken for germination were observed in P_1 (seed soaked in water) treatment whereas at 4th and 6th MAS same treatment was recorded maximum number of leaves. The maximum seedling diameter was found in P_5 treatment at 2 month and 6 month after sowing because of KCL that is responsible for enzyme activation and water regulation. It also creates hardyness in plant. While at 4 MAS maximum seedling diameter was found in P_4 (seed soaked in KH_2PO_4 @ 1%). This might be due to role of potassium dihydrogen phosphate which is responsible for cell division, cell development and plant growth.

Interaction effect

All the interaction effect of H and P was found to be significant on germination parameters and all vegetative parameters. Significantly, the highest germination % and survival % was recorded in treatment H_0P_2, H_0P_3, H_0P_5, H_0P_6, H_1P_4 and H_1P_6. This may be due to the beneficial effect of seed husking towards germination characters could be explained to the barrier effect of hard seed coat on germination of embryos and due to its damage effect on embryos release from the seeds. Thus, the preferable effect of husking mango seeds just before sowing might be attributed to the supply of oxygen and moisture to the embryos in order to help the seedling to emerge. The maximum days taken for germination (26.4 days) were recorded in H_0P_2 while the minimum days taken for germination (10.15 days) were observed in treatment H_1P_1. This may be due to congenial condition for early germination to husked seed soaked in water. Unhusked mango seed dipped in 1 % sucrose solution recorded longest height after four month of sowing which may be due to an enhanced sucrose enzyme activity in the apical part of the main stem and the part immediately below it might result in an increased availability of hexoses to these plant parts (Snageetha and Mani, 2014) [8]. The seedling diameter was maximum in H_1P_1 interaction at 2 and 4 MAS while the maximum seed diameter was observed in H_1P_5 at 6 MAS which was at par with H_1P_1. The maximum number of leaves per seedling was recorded in H_1P_1 treatment at 4 and 6 month after sowing. The variation in the number of leaves and their other vegetative growth parameters could be expected among the seedling, as the attribute is genetic character. The favourable effect of such seed treatments in seedling growth was in agreement with the results of Abdel-Galil, 2002 [1] who improved mango germination by removing seed coat.

Table 1: Effect of husking (removing seed tip) and pre-soaking treatments on germination (%), days taken for germination and survival (%) of mango cv. Alphonso

Treatments		Germination (%)	Days taken for germination	Survival (%)
Husking of seed (H)				
H_0 - Unhusked seed (intact seed)		89.61	23.08	91.10
H_1 - Husked seed (removing seed tip)		90.28	13.33	92.57
S.Em. ±		0.20	0.12	0.31
C. D. at 5%		0.57	0.35	0.90
Pre-soaking treatments (P):				
P_0 = Control (Seed as such)		86.60	17.94	86.68
P_1 = Seed soaking in Water		86.60	16.27	86.60
P_2 = Seed soaking in Cowdung slurry		93.30	19.78	93.30
P_3 = Seed soaking in KNO_3 @ 1%		90.0	18.19	96.67
P_4 = Seed soaking in KH_2PO_4 @ 1%		96.65	18.79	96.65
P_5 = Seed soaking in KCl @ 1%		93.00	17.82	96.67
P_6 = Seed soaking in Sucrose @ 1%		100.0	18.83	100.0
P_7 = Seed soaking in Banana sap @ 2%		93.30	17.19	96.65
P_8 = Seed soaking in GA_3 @ 100 ppm		70.03	19.06	73.33
S.Em. ±		0.41	0.26	0.66
C. D. at 5%		1.20	0.75	1.90
Interaction effect				
H×P	S.Em. ±	0.6	0.37.	0.94
	C. D. at 5%	1.7	1.06	2.70
	C.V. %	1.14	3.50	1.77

Table 2: Interaction effect of husking (removing seed tip) and pre-soaking treatments (H x P) on germination (%), days taken for germination and survival (%) of mango cv. Alphonso

Interaction (H x P)	Germination (%)	Days taken for germination	Survival (%)
H_0P_0	86.60	19.80	86.67
H_0P_1	86.60	22.38	86.60
H_0P_2	100.00	26.40	100.0
H_0P_3	100.00	23.13	100.0
H_0P_4	93.30	22.71	93.30
H_0P_5	100.00	22.93	100.0
H_0P_6	100.00	23.86	100.0
H_0P_7	86.60	22.38	100.0
H_0P_8	53.37	24.13	53.37
H_1P_0	86.60	16.08	86.70
H_1P_1	86.60	10.15	86.60
H_1P_2	86.60	13.15	86.60
H_1P_3	80.00	13.25	93.33
H_1P_4	100.00	14.87	100.0
H_1P_5	86.00	12.70	93.33
H_1P_6	100.00	13.80	100.0
H_1P_7	100.00	12.00	93.30
H_1P_8	86.70	14.00	93.30
S.Em. ±	0.60	0.37	0.94
C. D. at 5%	1.70	1.06	2.70

Table 3: Effect of husking (removing seed tip) and pre-soaking treatments on seedling height (cm) of mango cv. Alphonso

Treatments		Seedling height (cm)		
		2 MAS	4 MAS	6 MAS
Husking of seed (H)				
H_0 - Unhusked seed (intact seed)		38.50	59.63	63.58
H_1 - Husked seed (removing seed tip)		38.00	56.27	59.67
S.Em. ±		0.11	0.18	0.16
C. D. at 5%		0.34	0.52	0.45
Pre-soaking treatments (P):				
P_0 = Control (Seed as such)		40.50	57.80	61.90
P_1 = Seed soaking in Water		35.00	53.30	59.10
P_2 = Seed soaking in Cowdung slurry		41.77	63.50	65.40
P_3 = Seed soaking in KNO_3 @ 1%		37.80	57.90	60.90
P_4 = Seed soaking in KH_2PO_4 @ 1%		39.21	60.22	65.80
P_5 = Seed soaking in KCl @ 1%		41.10	62.80	65.50
P_6 = Seed soaking in Sucrose @ 1%		39.00	62.50	67.60
P_7 = Seed soaking in Banana sap @ 2%		35.30	52.70	56.80
P_8 = Seed soaking in GA_3 @ 100 ppm		34.60	50.85	51.60
S.Em. ±		0.25	0.38	0.33
C. D. at 5%		0.72	1.10	0.95
Interaction effect				
H×P	S.Em. ±	0.35	0.54	0.47
	C. D. at 5%	1.01	1.56	1.35
	C.V. %	1.61	1.62	1.32

MAS - Month After Sowing

Table 4: Interaction effect of huskinsg (removing seed tip) and pre-soaking treatments (H x P) on seedling height (cm) of mango cv. Alphonso

Interaction (H x P)	Seedling height (cm)		
	2 MAS	4 MAS	6 MAS
H_0P_0	44.00	61.80	65.80
H_0P_1	31.80	53.60	56.40
H_0P_2	40.13	61.40	64.40
H_0P_3	37.60	61.00	63.60
H_0P_4	38.83	64.80	72.20
H_0P_5	41.60	63.20	66.60
H_0P_6	42.40	67.80	74.60
H_0P_7	37.80	53.40	57.40
H_0P_8	32.40	49.70	51.20
H_1P_0	37.00	53.80	58.00
H_1P_1	38.20	53.00	61.80
H_1P_2	43.40	65.60	66.40
H_1P_3	38.00	54.80	58.20
H_1P_4	39.60	55.63	59.40
H_1P_5	40.60	62.40	64.40
H_1P_6	35.60	57.20	60.60
H_1P_7	32.80	52.00	56.20
H_1P_8	36.80	52.00	52.00
S.Em. ±	0.35	0.54	0.47
C. D. at 5%	1.01	1.56	1.35

MAS - Month after sowing

Table 5: Effect of husking (removing seed tip) and pre-soaking treatments on seedling diameter (mm) of mango cv. Alphonso

Treatments		Seedling diameter (mm)		
		2 MAS	4 MAS	6 MAS
Husking of seed (H)				
H_0 - Unhusked seed (intact seed)		4.10	5.95	7.03
H_1 - Husked seed (removing seed tip)		4.10	6.30	7.44
S.Em. ±		0.04	0.05	0.07
C. D. at 5%		NS	0.14	0.20
Pre-soaking treatments (P)				
P_0 = Control (Seed as such)		4.23	6.11	6.28
P_1 = Seed soaking in Water		4.28	6.40	7.22
P_2 = Seed soaking in Cowdung slurry		4.34	6.24	7.35
P_3 = Seed soaking in KNO_3 @ 1%		3.98	6.08	7.54
P_4 = Seed soaking in KH_2PO_4 @ 1%		4.15	6.57	7.75
P_5 = Seed soaking in KCl @ 1%		4.41	6.26	7.77
P_6 = Seed soaking in Sucrose @ 1%		4.04	6.13	7.21
P_7 = Seed soaking in Banana sap @ 2%		3.78	5.81	6.94
P_8 = Seed soaking in GA_3 @ 100 ppm		3.72	5.54	7.11
S.Em. ±		0.08	0.10	0.14
C. D. at 5%		0.23	0.30	0.42
Interaction effect				
H×P	S.Em. ±	0.11	0.15	0.21
	C. D. at 5%	0.33	0.42	0.59
	C.V. %	4.82	4.16	4.93

MAS - Month After Sowing

Table 6: Interaction effect of husking (removing seed tip) and pre-soaking treatments (H x P) on seedling diameter (mm) of mango cv. Alphonso

Interaction (H x P)	Seedling diameter (mm)		
	2 MAS	4 MAS	6 MAS
H_0P_0	4.42	6.03	6.36
H_0P_1	3.82	5.88	6.40
H_0P_2	4.26	6.16	7.16
H_0P_3	3.95	5.98	7.54
H_0P_4	4.36	6.51	7.60
H_0P_5	4.52	5.98	7.14
H_0P_6	4.18	6.00	6.86
H_0P_7	3.74	5.50	6.74
H_0P_8	3.64	5.58	7.52
H_1P_0	4.04	6.20	6.20
H_1P_1	4.74	6.92	8.04
H_1P_2	4.42	6.32	7.54
H_1P_3	4.00	6.19	7.54

H_1P_4	3.94	6.62	7.90
H_1P_5	4.30	6.54	8.40
H_1P_6	3.90	6.26	7.56
H_1P_7	3.82	6.13	7.14
H_1P_8	3.80	5.50	6.70
S.Em. ±	0.11	0.15	0.21
C. D. at 5%	0.33	0.42	0.59

MAS - Month After Sowing

Table 7: Effect of husking (removing seed tip) and pre-soaking treatments on number of leaves per seedling of mango cv. Alphonso

Treatments		Number of leaves per seedling		
		2 MAS	4 MAS	6 MAS
Husking of seed (H)				
H_0 - Unhusked seed (intact seed)		8.79	14.70	15.61
H_1 - Husked seed (removing seed tip)		9.25	15.94	17.24
S.Em. ±		0.07	0.12	0.07
C. D. at 5%		0.21	0.35	0.20
Pre-soaking treatments (P):				
P_0 = Control (Seed as such)		10.20	14.20	13.80
P_1 = Seed soaking in Water		9.88	17.57	19.02
P_2 = Seed soaking in Cowdung slurry		8.77	15.70	16.72
P_3 = Seed soaking in KNO_3 @ 1%		8.82	14.35	15.22
P_4 = Seed soaking in KH_2PO_4 @ 1%		8.60	15.32	16.02
P_5 = Seed soaking in KCl @ 1%		8.52	15.32	15.83
P_6 = Seed soaking in Sucrose @ 1%		9.03	16.70	18.42
P_7 = Seed soaking in Banana sap @ 2%		9.03	15.02	16.57
P_8 = Seed soaking in GA_3 @ 100 ppm		8.30	13.72	16.25
S.Em. ±		0.15	0.25	0.15
C. D. at 5%		0.43	0.72	0.42
Interaction effect				
H×P	S.Em. ±	0.21	0.36	0.21
	C. D. at 5%	0.61	1.02	0.59
	C.V. %	4.06	4.02	2.17

MAS - Month After Sowing

Table 8: Interaction effect of husking (removing seed tip) and pre-soaking treatments (H x P) on number of leaves per seedling of mango cv. Alphonso

Interaction (H x P)	Number of leaves per seedling		
	2 MAS	4 MAS	6 MAS
H_0P_0	10.40	12.80	11.80
H_0P_1	9.43	15.00	16.23
H_0P_2	8.27	14.40	15.83
H_0P_3	8.43	13.83	15.20
H_0P_4	8.60	16.83	18.63
H_0P_5	7.40	13.43	14.23
H_0P_6	9.27	18.60	19.63
H_0P_7	9.47	14.60	13.43
H_0P_8	7.80	12.83	15.50
H_1P_0	10.00	15.60	15.80
H_1P_1	10.33	20.13	21.80
H_1P_2	9.27	17.00	17.60
H_1P_3	9.20	14.87	15.23
H_1P_4	8.60	13.80	13.40
H_1P_5	9.63	17.20	17.43
H_1P_6	8.80	14.80	17.20
H_1P_7	8.60	15.43	19.70
H_1P_8	8.80	14.60	17.00
S.Em. ±	0.21	0.36	0.21
C. D. at 5%	0.61	1.02	0.59

MAS - Month After Sowing

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