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EFFECT OF SEED TREATMENTS TO ENHANCE SEED QUALITY OF PAPAYA (*CARICA PAPAYA* L.) CV.SURYA

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Abstract

To know the optimum fruit maturity stages, ideal temperature and media, dormancy breaking methods on seed quality parameters of papaya (*Carica papaya* L.) cv. Surya. Seeds extracted from fruits harvested at 1/4th1/2 th,3/4th and Complete yellow/orange and after ripening were subjected to dormancy breaking treatments, the result revealed that higher germination was recorded in GA3 @ 300ppm for 12 h and KNO3 @ 2% for 24 h (93.00 and 91.00% respectively). Bio inoculation of *Azotobacter chrococcum* for 20 days and Hot water soaking @ 50°C for 45 min recorded maximum germination respectively (92.50 and 78.00%), SVI (1387 and 969) field emergence (81.30 and 59.33%). Thus, Seed extraction from complete yellow/orange fruits, GA3, KNO3 and *Azotobacter chrococcum* treatments can enhance the germination and other seed quality parameters in papaya (*Carica papaya* L.) cv. Surya.

Key words: papaya, germination, TDH activity, Temperature, different media.

Introduction

Due to its striking nutritional and medicinal values, papaya fruit has occupied a unique place in the diet of people. It is a wholesome fruit having more carotene compared to other fruits such as apples, guavas, plantain, etc. It is one of the richest sources of vitamin A. It also contains vitamin C in appreciable quantity besides being high in sugars and pectins. The raw fruits are used for the treatment of gastric ulcers and other related stomach ailments. A ripen papaya fruit is delicious, nutritive, digestive and wholesome for people of all ages and hence papaya tree finds a place in almost every backyard. All these aspects have made papaya an ideal dessert fruit.

Propagation by seed is the universally followed method of multiplication in papaya. Though this m-ethod does not safeguard the purity of the progeny, it is inevitable because of the absence of any commercially feasible vegetative propagation technique. With the commercialization of papaya cultivation, the demand for quality seeds of well established varieties has increased. Few attempts have been made in the past to develop effective methods of producing quality seeds and maintain their viability.

Material and Methods

This experiment was conducted in the laboratory conditions of the department of seed science and technology, for this experiment the papaya fruits of complete yellow/orange stage were selected and harvested and the seeds from these fruits were extracted by adopting the earlier mentioned seed extraction The extracted seeds were further dried to 8 per cent moisture content by keeping them under open air conditions and soon after seed extraction the seeds were subjected to different methods of breaking of 200ppm, 300ppm and 400ppm, KNO3 @ 0.5%, 1%, 1.5% and 2% for 12 h, 24h, 36hand 48h, *Azotobacter chrococcum* treatment for 5 days, 10 days, 15 days and 20 days.

Preparation of test solutions

Giberellin (GA3)

The required quantity of gibberellins (GA3) was dissolved in little absolute ethyl alcohol solution and then diluted with distilled water to give a stock solution of 1000 ppm. From the stock solution, further dilutions were made according to the treatment requirement by using distilled water.

Potassium nitrate (KNO3)

It was prepared by dissolving 20 g of KNO3 in distilled water and volume was made upto 1000 ml. From the stock solution, further dilutions were made according to the requirement by using distilled water.

Giberellin treatment

The seeds were soaked in Giberellic acid (GA3) solution at four different concentrations 100 ppm, 200ppm, 300ppm, and 400ppm for (12hr, 24hr, 36hr, and 48hr). About hundred seedS in four replicates, for every treatment was used and they were tested for germination.

Potassium nitrate (KNO3) treatment

The Seeds were soaked in KNO3 solution at four different concentrations 0.5 (%), 1 (%), 1.5 (%), 2 (%) for (12hr, 24hr, 36hr, and 48hr). About hundred seed in four replicates, for every treatment was used and tested for germination.

***Azotobacter chrococcum* treatment**

Seeds were treated with 5g of *Azotobacter chroccum* per kg of seed for (5days, 10 days, 15 days and 20 days).Hundred seeds in four replicates, for every treatment were used and tested for germination.

Hot water treatment

Hundred seeds were tied in a muslin cloth bag in four replicates and exposed at 50°C for (10min, 20min, 30min, and 45min respectively) and tested for germination.

Field emergence

Different treatment treated seeds in twenty five each in four replicates were sown in open field and polyhouse conditions in well prepared bed. The emergence was noted at final count of germination.

observations were recorded

Germination (%)

The seeds were tested for germination by adopting BP method as per ISTA (1996).The germinated seedlings were evaluated on the final day of germination test. The total germination was expressed as per cent on the basis of number of normal seedlings obtained.

Seedling length (cm)

Ten normal seedlings from each replications were randomly selected for the measurement of root and shoot lengths in centimeters on the day of final count. The shoot length was measured from collar region to the point of attachment of cotyledon and root length from the collar region to the tip of primary root.

Seedling vigour index

Seedling Vigour Index (SVI) and (SVII) was calculated by adopting the method suggested by Abdul-baki and Anderson (1973) and expressed in whole number.

Results and Discussion

The result revealed that seeds treated with GA_3 at 300 ppm for 12 h recorded higher germination (93.00%) and were on par with the GA_3 at 100ppm for 36 h duration. The least germination percentage (64.00%) was observed in (untreated control soaking for 36 and 48 h. This is in agreement with findings of Deb *et al.,* (2010), Dhinesh babu *et al.,* (2010) and Anburani and Shakila (2010). The increase in germination percentage with GA_3 might be due to involvement of GA_3 in the activation of cytological enzymes along with increase in GA_3 cell wall plasticity and better water absorption.Maximum seedling length was seen in the untreated control at 36 h duration soaking (16.85 cm) followed by untreated control at 12 h duration soaking (14.15cm) and GA_3 at 400 ppm treatments at 24 h duration soaking (14.31cm) and minimum in untreated control at 48 h duration soaking (11.26cm). GA_3 at 400ppm for 12 h duration treatment showed maximum (4.10mg) seedling dry weight followed by GA_3 at 400ppm for 24h , 36h and 48h duration (4.00 mg) and least was recorded in untreated control at 48h soaking (3.40 mg). This may be attributed to GA increased the fresh and dry weights of seedlings and it also improved the rate of photosynthesis and research in greater accumulation of photosythates of papaya seedlings (Chacko *et al.,* 1966).The seeds of papaya treated with GA_3 at 400ppm with 12 h recorded higher seedling vigour index – I (1566) and lowest was observed in) untreated control with 48 h soaking in water (713). Vigour index in the GA_3 treatment might have resulted in more production of phtosynthates resulting in greater vigour index. (Anburani and Shakila, 2010) as indicated in the table 1 and 2.

Table 1.Seed quality as influence by the interaction of GA_3 ($T_)$ and Duration (D) in papaya (*Carica papaya* L.)

Treatment	Germination (%)					Fresh ungerminated seeds (%)				
	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
T_1	87.00 (69.10)	91.00 (72.90)	86.00 (68.15)	90.00 (71.2)	88.50	12.00 (19.92)	07.00 (15.14)	09.00 (17.32)	05.50 (13.22)	08.30
T_2	93.00 (74.80)	88.00 (70.22)	86.00 (68.20)	86.00 (68.7)	88.20	06.50 (14.48)	11.25 (19.47)	09.00 (17.12)	09.50 (17.80)	09.00
T_3	84.00 (66.50)	85.00 (67.86)	79.00 (63.13)	83.00 (66.4)	82.70	11.00 (19.11)	08.50 (16.66)	11.00 (19.11)	09.50 (17.89)	10.00
T_4	91.00 (73.40)	88.00 (70.60)	93.00 (75.05)	88.00 (69.8)	90.00	08.00 (15.77)	07.00 (13.01)	07.00 (14.94)	08.00 (16.16)	07.50
T_5	74.00 (59.74)	75.00 (60.07)	64.00 (53.28)	64.00 (53.18)	69.20	22.00 (27.49)	22.00 (27.78)	30.50 (33.29)	31.00 (33.58)	26.80
Mean	85.80	85.40	81.60	82.20		11.90	11.10	13.30	12.70	
	SEm±	CD (0.05P)				SEm±	CD (0.05P)			
T	1.22	3.45				1.21	3.43			
D	1.09	NS				1.08	NS			
TxD	2.44	NS				2.42	NS			

Table2. Seed quality as influence by the interaction of GA_3 ($T_)$ and Duration (D) in papaya (*Carica papaya* L.)

Treatment	Seedling length(cm)					Seedling dry weight(mg)				
	D1	D2	D3	D_4	Mean	D1	D2	D3	D_4	Mean
T_1	13.67	14.31	14.21	14.14	14.08	4.10	4.00	4.05	4.00	4.04
T_2	12.32	13.48	13.68	12.63	13.01	3.87	3.97	4.05	4.02	3.98
T_3	12.81	12.49	11.27	12.85	12.40	3.80	3.87	4.07	3.90	3.91
T_4	11.39	12.74	12.03	14.50	12.60	3.67	3.77	4.22	3.77	3.86
T_5	14.15	13.07	16.85	11.26	13.80	3.87	3.92	3.55	3.40	3.68
Mean	12.80	13.20	13.60	13.00		3.86	3.91	3.99	3.82	
	SEm±	CD (0.05p)				SEm±	CD (0.05p)			
T	0.27	0.78				0.05	0.16			
D	0.25	NS				0.05	NS			
T x D	0.55	1.56				0.11	0.32			

T_1: GA_3 @ 400ppm, D_1: 12h , T_2: GA_3 @ 300ppm, D_2: 24h T_3: GA_3 @ 200ppm D_3: 36h, T_4: GA_3 @ 100ppm D_4: 48h, T_5: CONTROL

T × D = Treatment × Duration

The seedling vigour index-II was significantly the highest (393) in seeds treated with GA_3 at 100ppm for 36 h whereas lowest in untreated control with 48 h water soaking (219). Dinesh babu *et al.*, (2010) recorded similar results. The hike in vigour might be due to the direct influence on the extensive growth of seedlings probably by increasing mobilization of reserve foods to growing apices (Nanda and Purohit, 1965)**.**Seeds treated with GA_3 at 400ppm for 12 h recorded the highest field emergence (84.00%). It was lowest (60.00%) in untreated control with 48 h soaking in water. This is in conforming to the work of Yogeesha *et al.,* (2007) and Claudinei *et al.,* (1993). As shown in the table 3 & 4.

KNO_3 at 2% for 24 h duration recorded significantly higher germination (91.00%) and least was observed in untreated control with 36 and 48 h soaking in water (64.00%). This is in agreement with the work of Satish kumar (2005), Alvarado *et al.,* (1987), Sathiyamoorthy and Nakamura (1995). This is due to the increasing KNO_3 concentration and shorter the duration maximized the germination whereas in case of water soaking without any concentration lead to increase in the germination when soaked for longer duration. Maximum increase in seedling length was observed in the (untreated control at 36 h duration soaking (16.85cm) followed by untreated control at 12 h duration soaking (14.15cm) and minimum seedling length was observed in untreated control at 48 h duration soaking (11.26cm). This result is conformity with the study of Sundstorm and Edwards (1989).The seedling dry weight was highest in KNO_3 at 0.5% and 48 h duration (4.15mg) followed by KNO_3 at 2%, at 36 h (4.05mg), KNO_3 at 2%, at 12h(4.02mg) and KNO_3 at 2%, at 24h (4.00mg) and it recorded lowest in untreated control at 48h soaking (3.40mg). This is due to the greater accumulation of photosythates in papaya seedlings. KNO_3 at 1% for 48 h recorded higher seedling vigour index – I (1212) and lower was observed in KNO_3 at 0.5% with 24 h soaking (678). This is in accordance with Gayathri, (2001), Renugadevi *et al.,* (1994), and Yogananda *et al.,* (2004).

Table3. Interaction effect of KNO_3 and duration on seed quality parameters of papaya seed (*Carica papaya* L.)

Treatment	Germination (%)					Fresh ungerminated seeds (%)				
	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
T_1	80.00 (63.50)	91.00 (72.90)	88.50 (70.26)	72.50 (58.60)	83.00	15.50 (23.15)	05.50 (11.75)	07.00 (15.24)	15.00 (22.40)	10.80
T_2	83.50 (66.28)	87.50 (69.49)	81.00 (64.34)	75.50 (60.41)	81.90	11.00 (18.41)	01.00 (2.88)	12.50 (20.66)	18.00 (25.05)	10.60
T_3	81.00 (64.55)	77.50 (61.70)	82.00 (65.02)	87.50 (69.68)	82.00	14.50 (21.90)	03.00 (09.83)	11.00 (18.91)	06.00 (11.19)	08.60
T_4	77.50 (61.77)	68.00 (55.71)	77.00 (61.35)	89.50 (71.28)	78.00	11.50 (19.54)	03.00 (07.08)	08.00 (16.10)	06.50 (14.29)	07.30
T_5	74.00 (59.74)	75.00 (60.07)	64.00 (53.28)	64.00 (53.18)	69.20	22.00 (27.49)	22.00 (27.08)	30.50 (33.29)	31.00 (33.58)	26.40
Mean	79.20	79.80	78.50	77.80		14.90	06.90	13.80	15.50	
	SEm±	CD (0.05p)				SEm±	CD (0.05p)			
T	1.11	3.13				1.44	4.06			
D	0.99	NS				1.28	3.63			
T x D	2.21	6.25				2.87	8.13			

Table 4.Influence of KNO_3 on seedling vigour index-I, seedling vigour index-II and field emergence (%) of papaya seed (*Carica papaya* L.)

Treatment	Seedling vigour index-I					Seedling vigour index-II					Field emergence (%)				
	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
T_1	0963	1013	1159	0946	1020	322	364	358	291	333	74.66 (60.12)	75.33 (60.37)	69.34 (56.56)	68.00 (55.75)	71.80
T_2	1017	0865	1033	0949	0966	325	348	326	300	325	74.66 (60.27)	77.30 (61.58)	74.67 (60.75)	69.30 (56.39)	73.90
T_3	1005	0825	1006	1212	1012	321	283	326	341	318	69.30 (56.77)	68.00 (56.95)	76.00 (60.76)	77.30 (62.09)	72.70
T_4	0898	0678	0968	1141	0921	303	240	308	371	306	74.60 (60.00)	70.00 (56.88)	72.60 (58.59)	68.60 (56.11)	71.50
T_5	1046	0978	1072	0713	0952	285	294	230	216	256	66.60 (54.75)	68.60 (55.57)	62.00 (51.97)	60.00 (50.77)	64.30
Mea n	0986	0872	1048	0992		311	305	309	303		71.90	71.80	70.90	68.60	
	SEm±	CD (0.05P)				SEm±	CD (0.05P)				SEm±	CD (0.05P)			
T	26.385	NS				7.342	20.765				1.959	NS			
D	23.600	66.740				6.567	NS				1.752	NS			
T x D	52.771	149.236				14.685	41.530				3.919	NS			

The seedling vigour index-II was significantly highest in the seeds treated with KNO_3 at 0.5% for 48 h (371) whereas the lowest in (T_5D_4) untreated control with 48 h water soaking (216).KNO_3 at 1.5% and 1%, for 24 h and 48h recorded highest field emergence (77.30%) which is on par with each other. It was lowest in untreated control with 48 h soaking in water (60.00%). This is in tune with the finding of Furutani *et al.,* 1987 and Tokuhisa *et al.,* 2007.

The germination percentage (92.50%), seedling vigour index – I (1387), field emergence (81.33%) were found to be highest in seeds treated with *Azotobacter chrococcum* for 20 days as compared to untreated control. Seedling length (15.28cm), seedling dry weight (4.17mg), Seedling vigour index-II higher (352) were highest in seeds treated with *Azotobacter chrococcum* for 5 days as compared with untreated control. This result is in tune with finding of Bhanavese *et al.,* (1990), Soleimanzadeh *et al.,* (2008), Sudhir and Shende (1982) and This is due to the beneficial effect of *Azotobacter* which is attributed to production of plant growth hormones, improved nutrient uptake and antagonistic effect on plant pathogens (Pamar and Dadarwal, 1997) as shown in the table 5.

Table 7.Influence of *Azotobacter chrococcum* on Seed quality parameters of Papaya (*Carica papaya* L.)

Treatments	Germination (%)	Fresh ungerminated seeds (%)	Seedling length(cm)	Seedling dry weight(mg)	Seedling vigour index-I	Seedling vigour index-II	Field emergence (%)
***A.chro*. 5D**	84.50 (66.82)	13.00 (21.12)	15.28	4.17	1292	352	77.33 (61.86)
***A.chro*.10D**	80.50 (63.90)	15.50 (23.03)	14.55	4.07	1171	328	72.67 (58.60)
***A.chro*.15D**	82.50 (65.64)	15.50 (22.73)	13.95	3.82	1153	314	74.00 (59.48)
***A.chro*.20D**	92.50 (74.39)	05.00 (12.56)	14.99	3.78	1387	348	81.33 (64.75)
Control	52.50 (46.43)	42.00 (40.36)	13.75	3.55	0732	187	48.00 (43.86)
Mean	78.50	18.20	14.50	3.87	1147	305.80	70.66
SEm±	1.87	1.91	0.35	0.12	45.93	13.08	3.15
CD (0.05p)	5.76	5.87	NS	NS	141.54	NS	NS

Conclusion

Seeds extracted from fruits harvested at $1/4^{th}1/2$ th,$3/4^{th}$ and Complete yellow/orange and after ripening were subjected to dormancy breaking treatments, the result revealed that higher germination was recorded in GA3 @ 300ppm for 12 h and KNO3 @ 2% for 24 h (93.00 and 91.00% respectively). Bio inoculation of *Azotobacter chrococcum* for 20 days and Hot water soaking @ 50°C for 45 min recorded maximum germination respectively (92.50 and 78.00%), SVI (1387 and 969) field emergence (81.30 and 59.33%).

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