Mysore J. Agric. Sci., 53 (4) : 34-39 (2019)

Standardization of Optimum Fruit Maturity Stage and Post Harvest Ripening Period to Achieve Better Seed Quality in Sponge Gourd

S. JEEVITHA AND S. N. VASUDEVAN
Department of Seed Science and Technology, University of Agricultural Sciences, Raichur - 584 104
E-mail : adrzarsmandya@gmail.com

ABSTRACT

A laboratory experiment was conducted in the Department of Seed Science and Technology, UAS, Raichur during 2017-18. The treatments details include three maturity stages (M_1: complete yellow, M_2: 50 per cent brown and M_3:100 per cent brown) and four post harvest ripening periods, R_1 (0^{th} day), R_2 (5^{th} day), R_3 (10^{th} day) and R_4 (15^{th} day). The results revealed that among the various maturity stages, fruits harvested at M_3 (100 per cent brown) stage was found to be best and among the post harvest ripening periods, R_1 (0 days) was found to be best for sponge gourd. Among the interactions, M_3R_1 (100 per cent brown and 0^{th} day) *i.e.,* the fruits harvested at complete brown stage and seed extraction done on the day of harvest was found to be superior in terms of seed quality parameters like seed weight per fruit, seed germination, dehydrogenase enzyme activity, shoot length, root length, seedling dry weight, seedling vigour index I, seedling vigour index II (24.5g, 88.1 %, 1.003 OD value, 24.2 cm, 24.3 cm, 910.9 mg, 4275, 80292 respectively). Lowest seed quality parameters noticed in M_1R_1 was (12.9 g, 70.1 per cent, 0.447 OD value, 19.9 cm, 19.9 cm, 775.9 mg, 2794, 54481).

Keywords: Sponge gourd, Postharvest ripening, Germination and Dehydrogenase enzyme activity

SPONGE GOURD [*Luffa cylindrica* (L.)] is also known as 'Luffa, Bath sponge, Towel gourd, Dishrag gourd, Vegetable sponge, Rag gourd, Smooth luffa, Scrubber gourd and Wild vegetable sponge'. Luffa is widely cultivated vegetable in the family Cucurbitaceae, which is easy to grow hence it is grown throughout Asia and the United States for the food and scrubbers although it is inherent to Tropical Africa and Asia. Sponge gourd is highly cross pollinated and monoecious crop with chromosome number 2n = 26. Flowers are deep yellow in color, unisexual and situated at different internodes. Sponge gourd contains high fibre which is used as cleansing agent and making table mats, shoes soles etc. In India, it is cultivated extensively in the states of Madhya Pradesh, Tamil Nadu, Uttar Pradesh, Andra Pradesh, Kerala and Maharashtra. In India it occupies an area of 41 m ha with the production of 641 m t and productivity of 15.63 t/ha (Handbook of Horticulture Statistics, 2014). Most of the cucurbitaceous vegetables are usually cultivated in relatively small areas for local consumption and hence the statistical data on area and production are lacking (Anon., 2016). Harvesting of fruits at optimum stage of maturity and drying not only minimizes the loss of viability and vigour of seeds but also prevents adverse effect of environmental conditions. Research work on stages of harvest is scanty. The fruits develop and attain physiological maturity at different times owing to indeterminate flowering habit. Generally, fruits harvested at physiological maturity produce high quality seed in terms of germination and vigour as compared to fruits harvested at earlier or later stage of maturity. It is also argued that seeds obtained from fruits harvested even before attainment of physiological maturity and allowed for post harvest ripening for few days may also produce good quality seeds. Since, the development of seed continues in fleshy fruits owing to continuous supply of nutrients and food reserve from fruit to seed. Under open field condition, there is a chance of incidence of diseases, pest and also development of more number of male flowers in cucurbits due to increased temperature condition. Hence, the present study was planned and executed to know the influence of maturity stages and post

harvest ripening periods in seed quality parameters of sponge gourd seeds.

Material and Methods

Laboratory experiment was conducted in the Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur, during 2017-18 to find out the influence of fruit maturity stages and post harvest ripening periods on seed quality of sponge gourd. The treatments details include three different maturity stages (M_1: complete yellow, M_2: 50 per cent brown and M_3:100 per cent brown) and four different post harvest ripening periods, R_1 (0^{th} day), R_2 (5^{th} day), R_3 (10^{th} day) and R_4 (15^{th} day). Germination percentage and seedling length, were determined as per International Seed Testing Association rules for seed testing (ISTA, 2013). Hundred seeds each in four replications were placed in rolled paper towels and incubated at a constant temperature of 25ºC and 90 per cent relative humidity and the per cent germination was evaluated on 14^{th} day and was expressed on normal seedling basis. Seedling length of ten randomly selected normal seedlings was measured replication wise from tip of shoot to root tip and the mean length was calculated and expressed as seedling length in centimeter. Ten randomly selected seedlings used for measuring seedling length were dried at 70±1ºC for 24h in hot air oven and the mean seedling dry weight was expressed in gram. The seedling vigour index I and II were determined by multiplying the germination percentage and total seedling length and multiplying germination percentage and total seedling dry weight respectively (Abdul-Baki and Anderson, 1973). For assessing dehydrogenase activity twenty five representative seeds from each treatment were taken and preconditioned by soaking in water over night at room temperature then embryos were excised and steeped in 0.25 per cent solution of 2, 3, 5 - triphenyl tetrazolium chloride and kept in dark for two hours at 40 ºC for staining. The stained embryos were thoroughly washed with water and then soaked in 10ml of 2-methoxy ethanol (methyl cellosolve) and kept overnight for extracting the red colour formazan. The intensity of red colour was measured using ELICO UVVIS spectrophotometer (model SC-159) using blue filter at 470 nm wavelength and methyl cellosolve as blank. The OD value obtained was reported as dehydrogenase activity (Kittock and Law, 1968).

Results and Discussion

Seed production is highly technically skilled job and involves huge labour and financial risk. The seed crop may be raised successfully but harvested at inappropriate stage may lead to complete loss of seed yield and quality on account of field weathering besides heavy financial loss. Hence, among several cultural practices, harvesting of the seed crop at right stage of maturity assumes greater importance for obtaining higher seed yield and quality. Seeds harvested at right stage (physiological maturity) will be well developed, matured and possess maximum viability and vigour. On the contrary, early harvesting prior to physiological maturity drastically lowers seed yield and quality on account of under developed and immature seeds.

Therefore, the present investigation was carried out with three fruit maturity stages *viz.,* M_1: 100 per cent complete yellow, M_2: 50 per cent brown, M_3: 100 per cent brown and four stages of post harvest ripening periods *viz.,* R_1: 0 day, R_2: 5 days, R_3: 10 days, R_4: 15 days to determine the optimum fruit maturity stage and post harvest ripening period in sponge gourd. The findings of the investigations are discussed below. Successful completion of the experiment which are carried exclusively for seed production depends on the quantity of seeds produced at the end. The main and foremost objective of any such experiment is to have optimum seed yield and better returns. The seed yield is inherent to the quality of crop produced. In the present study, fruit weight differed significantly due to maturity stages and post harvest ripening. The treatment, M_1 recorded higher fruit weight (80.2gm) and lower was in M_3 (49.0gm). The loss in fresh weight of fruit recorded during the maturity stages can be attributed to dehydration, maturity drying and loss of moisture (Table 1). The reduction in fruit moisture content with advancement of maturity might be due to the development of seeds and fiber in the fruit. The results obtained are in conformity with the findings of

TABLE 1

Effect of maturity stages and post harvest ripening period on fruit weight, seed moisture content and number of seeds per fruit in sponge gourd

Treatments	Fruit weight (g)				Seed moisture content (%)				Number of seeds per fruit			
	M1	M2	M3	Mean	M1	M2	M3	Mean	M1	M2	M3	Mean
R1	130.2	63.3	51.5	81.6	25.0 (30.0) *	23.0 (28.6)	10.1 (18.5)	19.31 (25.7)	93.6	192.3	194.3	193.4
R2	95.0	56.5	49.0	67.1	19.0 (25.8)	14.0 (21.9)	9.2 (17.6)	14.0 (21.8)	193.0	194.0	194.0	193.6
R3	49.9	48.0	45.5	47.8	12.0 (20.2)	10.0 (18.4)	8.6 (17.0)	10.2 (18.5)	194.0	194.1	194.2	194.1
R4	47.6	45.7	44.8	46.0	10.0 (18.4)	9.0 (17.4)	8.3 (16.7)	9.1 (17.5)	193.3	194.2	194.1	193.8
Mean	80.2	52.5	49.0	60.5	16.5 (23.6)	14.0 (21.6)	9.0 (17.5)	13.1 (20.8)	193.5	193.6	194.1	193.7
Factors	S.Em±		CD @ 1 %		S.Em±		CD @ 1 %		S.Em±		CD @ 1 %	
M	0.5		1.6		0.1		0.3		0.4		NS	
R	0.6		1.8		0.1		0.4		0.4		NS	
M x R	1.1		3.2		0.2		0.7		0.8		NS	

Legend M : fruit maturity stage
M_1: 100 Per cent yellow
M_2: 50 Per cent brown
M_3: 100 Per cent brown
R : post harvest ripening period
R_1: 0 day R_3: 10 days
R_2: 5 days R_4: 15 days
NS: Significant

Shamsheer (2006). Mean seed weight per fruit and 100 seed weight were highest in M_3 (21.8 mg and 11.7 gm) while, lowest in M_1 (13.8 gm and 7.0 mg). At physiological maturity, seeds are said to be completely developed due to maximum accumulation of food reserves, amino acid, phosphorous active substances, dry matter, sugar, water soluble proteins, acids level in the seeds. This might be due to better development of seeds on account of greater accumulation of food reserves in the seeds resulting in higher seed weight. Lower seed test weight at early harvest might be due to less accumulation of dry matter/food reserve as compared to optimum maturity. The decrease in seed weight over a period of ripening was due to high maintenance of respiration after physiological maturity during which there is no extra food reserve moving from source to sink. So, seeds have to utilize food reserve stored in endosperm to continue the normal biochemical processes (Devaraju *et al*., 2013 in cucumber). Germination is one of the key criteria for determining the physiological aspect of seed and gives an idea about the ability of seed to produce normal and healthy seedlings under the field condition. In the present investigation, among different maturity stages, maximum germination and dehydrogenase enzyme activity was recorded in M_3 (82.1 % and 0.899 OD value) while, minimum was in M1 (74.7 % and 0.688 OD value) (Table 2). This might be due to better development of seeds on account of greater accumulation of food reserves in the seeds resulting in higher vigour and germinability. At physiological maturity, seeds are said to be completely developed due to maximum accumulation of food reserves, amino acids, phosphorous active substances, dry matter, sugar, water soluble proteins, acids and nicotinic acid levels in the seeds. On the contrary, all seed quality parameters were low in early harvested fruits (M1), due to presence of large number of immature and under

TABLE 2

Effect of maturity stages and post harvest ripening period on 100 seed weight, Seed weight per fruit and germination in Sponge gourd

Treatments	100 seed weight (g)				Seed weight per fruit (g)				Germination			
	M1	M2	M3	Mean	M1	M2	M3	Mean	M1	M2	M3	Mean
R1	6.7	8.2	12.5	9.0	12.9	15.7	24.5	17.7	70.1 (56.8) *	71.4 (57.6)	88.1 (69.9)	76.5 (61.5)
R2	6.8	8.3	12.1	9.0	13.8	16.6	23.3	17.9	71.4 (57.7)	76.2 (60.7)	86.1 (69.4)	77.9 (62.6)
R3	7.1	8.6	11.4	9.1	13.9	20.7	21.4	18.6	72.1 (58.1)	86.7 (68.6)	81.1 (68.0)	79.9 (64.0)
R4	7.6	12.4	11.0	10.3	14.7	24.1	18.0	18.9	85.1 (67.3)	87.0 (69.4)	73.1 (68.1)	81.7 (68.3)
Mean	7.0	9.3	11.7	9.3	13.8	19.2	21.8	18.2	74.7 (59.9)	80.3 (64.1)	82.1 (68.5)	78.5 (64.3)
Factors	S.Em ±		CD @ 1 %		S.Em ±		CD @ 1 %		S.Em ±		CD @ 1 %	
M	0.08		0.2		0.1		0.4		0.6		1.9	
R	0.09		0.2		0.1		0.5		0.7		2.2	
MXR	0.16		0.4		0.3		0.8		1.3		3.9	

Legend M : fruit maturity stage
M_1: 100 Per cent yellow
M_2: 50 Per cent brown
M_3: 100 Per cent brown

R : post harvest ripening period
R_1: 0day R_3: 10days
R_2: 5days R_4: 15 days

developed seeds with lesser food reserves and nutrients in the seeds. Attainment of maximum seed quality at the end of seed filling *i.e.* physiological maturity is crucial in seed crops where viability and vigour is essential for seedling establishment in the field. In a number of cucurbits, seed maturation usually continues until the fruit starts to turn light green or yellow colour with senescence. The very low seed germination in the fresh fruit might be due to the dormancy associated with fresh seeds.

Among the ripening periods, highest seed germination and dehydrogenase enzyme activity were recorded in R_4 (81.7 % and 0.870 OD value) whereas, R_1(76.5 % and 0.718 OD value) recorded lower seed germination and dehydrogenase enzyme activity (Table 3). Among the interactions, M_3R_1 recorded higher seed germination (88.1%) and dehydrogenase enzyme activity (1.003 OD value). Whereas, lowest in M_1R_1 (70.1%). Shoot length and root length were recorded highest in M_3 (23.1cm and 23.7 cm) whereas, M_1 (20.4 cm and 20.5 cm, respectively) recorded lower shoot and root length. So also, shoot length (22.3 cm) and root length (23.0 cm) was highest in R_4 while, R_1 (21.3cm and 22.0 cm) recorded the lowest. Similarly, seedling dry weight (880.7mg), seedling vigour index I (4091) and seedling vigour index II (76875) were highest in M_3 whereas, M1 (812.8) recorded the lowest (Table 4). Among the interactions, M_3 R_1 recorded higher seedling dry weight (910.9 mg), seedling vigour index I (4275) and seedling vigour index II (80292). Whereas, lowest was in M_1 R_1. This might be due to better development of seeds on account of greater accumulation of food reserves in the seeds resulting in higher vigour and germinability.

In Sponge gourd seed production, fruits harvested at complete brown stage and seed extraction done on

TABLE 3

Effect of maturity stages and post harvest ripening period on dehydrogenase enzyme activity, shoot and root length in sponge gourd

Treatments	Dehydrogenase enzyme activity (OD value)				Shoot length (cm)				Root lenght (cm)			
	M1	M2	M3	Mean	M1	M2	M3	Mean	M1	M2	M3	Mean
R1	0.447	0.747	1.003	0.718	19.9	19.8	24.2	21.3	19.9	21.8	24.3	22.0
R2	0.750	0.815	0.880	0.817	20.0	20.7	23.3	21.3	20.0	22.3	23.7	22.0
R3	0.760	0.900	0.870	0.843	20.7	21.4	23.2	21.8	20.7	22.4	23.6	22.2
R4	0.777	0.990	0.843	0.870	21.0	24.1	22.8	22.3	21.5	24.2	23.4	23.0
Mean	0.688	0.863	0.899	0.859	20.4	21.5	23.1	21.6	20.5	22.7	23.7	22.3
Factors	S.Em ±		CD @ 1 %		S.Em ±		CD @ 1 %		S.Em ±		CD @ 1 %	
M	0.007		0.021		0.1		0.5		0.1		0.5	
R	0.008		0.024		0.2		0.6		0.2		0.6	
MXR	0.014		0.041		0.3		1.0		0.3		1.1	

Legend M : fruit maturity stage
M_1: 100 Per cent yellow
M_2: 50 Per cent brown
M_3: 100 Per cent brown
R : post harvest ripening period
R_1: 0day R_3: 10days
R_2: 5days R_4: 15 days

TABLE 4

Effect of maturity stages and post harvest ripening period on seedling dry weight, seedling vigour index I and seedling vigour index II in sponge gourd

Treatments	Seedling dry weight (mg)				Seedling vigour index - I				Seedling Vigour Index - II			
	M1	M2	M3	Mean	M1	M2	M3	Mean	M1	M2	M3	Mean
R1	775.9	752.4	910.9	813.1	2794	2975	4275	3348	54481	53810	80292	62861
R2	821.4	839.1	890.6	850.4	2860	3277	4119	3419	58745	63333	78057	66711
R3	823.6	854.8	882.0	853.5	2989	3803	4078	3624	59480	74234	76861	70192
R4	830.1	901.0	839.2	856.8	3622	4238	3893	3918	61590	79059	72291	70980
Mean	812.8	836.8	880.7	843.4	3067	3573	4091	3577	58574	67609	76875	67686
Factors	S.Em ±		CD @ 1 %		S.Em ±		CD @ 1 %		S.Em ±		CD @ 1 %	
M	7.1		21.3		30		89		583		1714	
R	8.2		24.6		35		103		674		1979	
MXR	14.2		41.8		61		179		1167		3428	

Legend M : fruit maturity stage
M_1: 100 Per cent yellow
M_2: 50 Per cent brown
M_3: 100 Per cent brown
R : post harvest ripening period
R_1: 0day R_3: 10days
R_2: 5days R_4: 15 days

the day of harvest M_3R_1 (100 % brown and 0th day), found to be superior in terms of seed quality parameters.

REFERENCES

ABDUL-BAKI, A. A. AND ANDERSON, J. D., 1973, Vigour determination of soybean seeds by multiple criteria. *Crop. Sci*., **13** : 630 - 633.

ANONYMOUS, 2016, Crop wise area and production of horticulture crops in Karnataka.

DEVARAJU, P. J., CHETAN, H. N. AND DINESH, H. B., 2013, Influence of fruit harvesting stage on seed quality of cucumber (*Cucumis sativus* L.) cv. Hassan local. *Int. J. Agric. Sci.,* **9** (2) : 636 - 639.

HANDBOOK ON HORTICULTURE STATISTICS, 2014, Government of India, Department of Agriculture Cooperation, New Delhi.

ISTA, 2013, International Rules of Seed Testing. *Seed Sci.Tech*., **27** : 25 - 30.

KITTOCK, P. A. AND LAW, A. G., 1968, Relationship of seedling vigour to respiration and tetrazolium chloride reduction of germinating wheat seeds. *Agron. J.,* **60** : 286 - 288.

SHAMSHEER, A., 2006, Effect of growth regulators and stages of fruit harvest on seed yield and quality in paprika chilli (*Capsicum annum* L.) cv. Kt-PT - 19. *M.Sc. (Agri.)*. *Thesis*, Univ. Agri. Sci., Dharwad.

(*Received :* July, 2019 *Accepted :* September, 2019)