Indicators of Seed Maturation in *Prunus armenica* L. in Indian Himalayan Region.

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Received: July 10, 2018 Accepted: August 27, 2018

ABSTRACT *Wild apricot (Prunus armenica L.) is an important multipurpose tree species of the Himalayan region. The mature seed (kernels) of the species yields oil used for various edible, cosmetic and industrial preparations. The present study was carried out to assess the exact time of seed maturation and germination of Wild apricot (Prunus armenica) at 04 sites of Nainital district during two consecutive years 2015 and 2016. Vegetative analysis was done by placing 20 permanent plots of 10×10 m² randomly in the study area. Fruit were collected at 10 days intervals directly from the marked tree till the availability of fruits from all the sites. Different physical parameters were taken to assess the seed maturity. The change of fruit colour from green to yellow was found the indicator for the fruit maturation but did not coincide with seed maturation. No germination was occurred till the last collection of fruits/seeds. Seeds were stored at the last collection from all the sites. 05 replicates of 25 seeds were kept in germinator at 20⁰C to assess the seed germination at monthly interval and experiment continued till germination started to decline. The maximum germination in stored seeds was 62.67 ± 5.81% when moisture content of the stored seeds was 22.18 ± 1.36%. Thus in the present study moisture content appears to be an important indicator of the seed maturity of the species.*

Keywords: *Wild apricot, Seed Maturation, Germination, Moisture Content, Morphological Characters.*

Introduction

Wild Apricot (*Prunus armeniaca* L.) is an important fruit tree species commonly known as "Chullu". It is found in the dry temperate regions of North-Western Himalayas particularly in the valleys of Jammu & Kashmir (especially Ladakh), Chenab; Kullu and Shimla regions of H.P. and Garhwal and Kumaun hills of Uttrakhand at 3000 m altitude. It is a small sized deciduous tree species varying in height between 4-8m. It is one of the important multipurpose trees in the region under existing systems of agroforestry (Singh and Chaudhary, 1993). Fats and oils are an important food source for man, and are supplying essential fatty acids such as linoleic and arachidonic acids (Rauken and Kill, 1993; Bachheti et al., 2012). The mature seed (kernels) of the species yields edible oil. The apricot oil can be considered as good edible oil and can be utilize for other industrial purposes (Gupta et al., 2012).

Seed maturity is the physiological and functional changes that occur from time until the seeds are set for harvest. Maturity is a critical and most important factor that determines the size and the quality of the seed. Physiological maturity is defined as the occurrence of maximum seed dry weight and represents the end of dry weight accumulation and seed filling period. It has been widely adopted as an important growth stage and used by researchers and producers because it represents the end of active plant growth and the production of yield (Malarkodi and Srimathi, 2006). Seed germination is the ability of seeds to produce normal seedlings under optimum conditions (Samarah, 2005). Germination takes place only when mature, viable seeds are supplied with adequate moisture and effective temperature, which varies from species to species. Some species also require light and pre-treatments in addition to moisture and temperature. The four factors viz; moisture, temperature, light and pre- treatment are therefore regarded as essential factors that control germination (Justce, 1972; ISTA, 1976). Grisez et al., (2008) have reported that the seed germination in *P. armeniaca*, *P. avium*, *P. domestica*, *P. mahaleb*, *P. padus*, *P. pensylvanica*, and *P. serotina* has been significantly higher after warm stratification plus cold stratification than after cold stratification only. The International Seed Testing Association, (1999) suggested 3-4 months of cold stratification for the seeds of *P. avium, P. padus and P. serotina* for the germination. Wild apricot, kernel weight is directly related with oil yield, it is a complex character and it is dependent on a number of nut components. Information on the association of different characters among themselves and their relationship with kernel weight is very important produce of the species (Wani and Mugahal, 2017). The present study focused on assessing the exact time of fruit/seed maturation and germination behaviour of the species.

MATERIAL AND METHODS

Site Description and vegetative analysis: The study was carried at 04 sites of Nainital district during two consecutive years 2015 and 2016. The sites were located between 1642 and 2170 m altitude. 20 permanent plots of 10×10 m^2 were placed randomly in the study area. The diameter was measured with help of meter tape and height was measured with the help of ravi multimeter (Saxena and Singh, 1982).

Table 1. Details of the studied sites.

S. No.	Site	Elevation (masl)	Coordinates	Density (indi./ha)
1.	Chiyori Dhura (S1)	1687	N 29°30'16.99" and E 79°31'51.13"	70
2.	Talla Ramgarh (S2)	1642	N 29°26'26.38" and E 79°33'44.06"	50
3.	Budibana (S3)	1858	N 29°26'45.44" and E 79°37'28.47"	65
4.	Satbunga(S4)	2170	N 29°26'35.14" and E 79°33'44.06"	95

Morphological Fruit /seeds Characters and Seed maturation

Fruit were collected at 10 days intervals and were collected directly from the marked tree till the availability of fruits from all the sites. Collected fruits were brought back to the laboratory and fruits of all trees at one collection date were mixed thoroughly to make a composite sample. From the composite sample, three replicates were taken for determining different morphological characters of the fruits/seeds (size, fresh/weight and moisture percentage). Fruits were manually de-pulped to extract seeds. Fruit/seed size (length × width) was measured with digital vernier caliper (Model No. CD-6"CS, accuracy + 0.02mm Mitutoyo, Co.). Weight of 100 fruits/seeds was recorded with digital electronic balance (Dolfin make) (Tewari et al., 2016). Moisture content percentage was calculated for each collection date using three replicates of fruits/seeds each. The moisture content of fruits/seeds was estimated on fresh weight basis by drying at 103 ± 2°C for 16 ± 1 hr (ISTA, 1993).

Germination and moisture content of stored seeds: For determining the seed maturation time, 3 kilogram seed of each site was stored in air tight plastic containers at the last collection. Five replicates of 25 seeds were kept in germinator at 20°C to assess the seed germination at monthly interval and experiment continued till germination had declined to below 10%. Germination was recorded when the radical began to appear and was up to 2mm long at monthly interval. Seed moisture content of the stored seed was also estimated (ISTA, 1993; Tewari et al., 2016).

RESULTS

Phytosociological analysis: In the study area the distribution of wild apricot was found in the bunds of the agricultural lands and on village paths associated with *Ficus roxburghii, Grewia optiva, Quercus leucotrichophora, Pinus roxburghii*. The density of the species ranged between 50 and 95 indi/ha. The maximum density 95 indi/ha was found in Satbunga (S4) and minimum 50 indi/ha was in Talla Ramgarh (S2) (Table 1).

Fruits/seeds characters

Colour of fruits and seeds: During the collection period fruits colour was changed from green to yellow and seed colour change from light brown to dark brown ((Table 2 and Table 3). The fruits colour is the main visible character to identifying the fruits are ready to harvesting.

Fruit and seed size: In Yr-1 the fruit size of wild apricot ranged from 436.73 ± 3.17 mm^2 to 1269.61 ± 3.34 mm^2 and seed size was 223.19 ± 3.16 mm^2 to 465.66 ± 3.09 mm^2 (Table 2). In Yr-2 the fruit size of wild apricot was ranged from 440.30 ± 3.18 mm^2 to 1295.09 ± 2.30 mm^2 and seed size was 232.49 ± 2.12 mm^2 to 591.49 ± 2.97 mm^2 (Table 3). The fruit size of Yr-2 was comparatively larger than the fruit and seed size in Yr-1. The maximum fruit/seed size was recorded in S4 and minimum was in S2 in both the year (Table 2 and Table 3). ANOVA showed that fruit size varied significantly across the sites and dates and not varied significantly across the years ($P < 0.05$). The seed size varied significantly across the years, sites and dates ($P < 0.05$). The interaction between year × site, year × date, site × date and year × site × date was significant for both fruit size and seed size ($P < 0.05$).

Fruit and seed weight: The weight of 100 fruits ranged from 639.84 ± 5.84g to 1610.30 ± 6.49g and weight of 100 seeds 119.13 ± 4.13g to 274.75 ± 3.43g in Yr-1. In Yr-2 the weight of 100 fruits ranged from 641.27 ±

5.96g to 1633.24 ± 12.67g and weight of 100 seeds 120.61 ± 2.42g to 305.65 ± 6.48g. ANOVA shows that the weight of 100 fruits and weight of 100 seeds was varied significantly across the years, sites and dates. The interaction between year × site, year × date, site × date and year × site × date was significant for weight of 100 fruits ($p < 0.05$). For weight of 100 seeds the interaction between year × site and site × date was significant and not significant between year × date and year × site × date ($P < 0.05$).

Number of fruits and seeds per 100g: In Yr-1 number of fruits in 100g varied between 4.00 ± 0.33 and 14.33 ± 0.33 and in case of seed it was varied from 41.33 ± 2.03 to 100.67 ± 0.67 (Table 2). In Yr-2 the number of fruits ranged from 3.67 ± 0.33 to 14.33 ± 0.33 and number of seed per 100g was 41.67 ± 1.45 to 99.33 ± 1.45 (Table 3). The number of fruits/seeds in 100g was decreased as the fruit/seed size and weight was increased. ANOVA shows that the number of fruits and seeds in 100g was varied significantly across the years, sites and dates ($P <0.05$). The interaction between year × site and site × date was significant and not significant between the year × date and year × site × date ($P <0.05$).

Germination and moisture content of fresh fruits/seeds: During the collection period the moisture content of fruits in Yr-1 was ranged between 78.75 ± 0.74% and 51.26 ± 1.25% and seed moisture content was ranged between 60.27 ± 1.17% and 29.79 ± 0.40% (Table 2). In Yr-2 the moisture content of fresh fruits ranged between 78.05 ± 0.52% and 50.23 ± 0.34% and seed moisture content ranged from 61.83 ± 2.07% to 28.46 ± 0.77% (Table 3). No germination occurred when moisture content percent of the fresh seeds remained above. ANOVA showed that the fruit and seed moisture content percent of fresh fruits/seeds varied significantly across the sites and dates and not across the years ($P < 0.05$). The interaction between site × date was significant and insignificant between year × site, year × date and year × site × date for fruit moisture content. The interaction between year × site, year × date, site × date and year × site × date was not significant for seed moisture content percent of fresh seed.

Germination and moisture content of stored seeds: In Yr-1 the moisture content ranged between 29.03 ± 2.14% and 18.07 ± 1.27% and germination ranged between 0.00 ± 0.00% and 62.67 ± 5.81%. In Yr-2, the moisture content ranged between 29.51 ± 0.17% and 18.12 ± 1.08% and germination ranged between 0.00 ± 0.00% and 60.00 ± 2.31% (Table 4). The maximum germination was recorded during the months of Jan-Feb (after 6-7 month after seed storage) and minimum was recorded during the months of Aug-Sep. From the month of March germination began to declining. In both years the maximum germination was recorded in site S4. During the maximum germination the seed moisture content ranged from 20.78 ± 0.31% to 19.25 ± 0.84% (Table 4). ANOVA showed that the seed moisture content percent varied significantly across the months ($P< 0.05$) but did not vary significantly across the years and sites. The interaction between year × site was significant ($P < 0.05$) and was not significant between year × month, site × month and year × site × month. The germination percent varied significantly across the sites and months ($P < 0.05$) but did not vary significantly across the years. The interaction between site × month was significant ($P < 0.05$) but interaction between year × site, year × month and year × site × month was no significant.

Table 2. Morphological Characters of Fruit/Seed in Year-1

Sites	Date of Collection	Colour		Size (mm²)		Weight of 100 Fruit/Seed (g)		Number of Fruit/Seed in 100g		Moisture content %	
		Fruit	Seed	Fruit	Seed	Fruit	Seed	Fruit	Seed	Fruit	Seed
S1	21-05-2015	G	LB	599.33 ± 1.71	301.67 ± 2.34	797.39 ± 4.39	152.57 ± 5.77	7.33 ± 0.33	79.67 ± 2.73	78.17 ± 1.64	59.82 ± 0.94
	31-05-2015	G	LB	698.86 ± 1.32	333.68 ± 2.31	908.82 ± 6.44	170.90 ± 4.52	6.33 ± 0.33	70.67 ± 1.76	77.34 ± 1.18	55.54 ± 2.05
	10-06-2015	G	LB	749.07 ± 2.11	402.98 ± 3.18	1120.11 ± 10.93	210.58 ± 6.47	5.67 ± 0.33	63.33 ± 2.96	76.47 ± 0.49	46.68 ± 2.42
	20-06-2015	YG	B	830.00 ± 2.48	410.84 ± 2.91	1237.85 ± 8.26	230.76 ± 2.67	5.33 ± 0.33	55.33 ± 2.33	67.10 ± 1.52	41.61 ± 1.28
	30-06-2015	YG	B	1106.02 ± 2.47	416.97 ± 1.20	1563.39 ± 10.76	243.07 ± 2.71	4.67 ± 0.33	47.67 ± 1.76	55.57 ± 1.26	37.85 ± 1.01
	10-07-2015	Y	DB	1193.24 ± 1.96	422.15 ± 1.76	1597.34 ± 3.16	265.14 ± 3.36	4.67 ± 0.33	44.33 ± 2.03	53.02 ± 1.47	34.39 ± 1.34
	20-07-2015	Y	DB	1229.88 ± 1.90	438.18 ± 0.82	1603.09 ± 6.66	259.46 ± 2.96	4.33 ± 0.33	42.33 ± 1.86	52.85 ± 1.55	31.28 ± 0.42
S2	21-05-2015	G	LB	436.73 ± 3.17	223.19 ± 3.16	639.84 ± 5.84	119.13 ± 4.13	14.33 ± 1.20	100.67 ± 0.67	78.75 ± 0.74	60.27 ± 1.17
	31-05-2015	G	LB	494.23 ± 8.45	238.49 ± 3.05	686.21 ± 7.54	130.12 ± 4.57	11.33 ± 0.67	96.67 ± 0.88	73.29 ± 0.65	54.39 ± 1.24
	10-06-2015	G	LB	555.83 ± 4.41	285.35 ± 3.78	765.06 ± 9.81	136.86 ± 8.26	9.67 ± 0.33	92.33 ± 1.76	72.33 ± 0.70	48.19 ± 0.93
	20-06-2015	YG	B	603.92 ± 4.34	316.19 ± 3.65	835.56 ± 8.18	152.39 ± 9.10	8.67 ± 0.33	80.67 ± 2.40	70.68 ± 0.72	41.04 ± 1.09
	30-06-2015	YG	B	683.70 ± 4.23	342.38 ± 4.47	883.66 ± 9.67	174.47 ± 6.83	8.67 ± 0.33	69.67 ± 1.20	68.90 ± 0.34	36.41 ± 1.76
	10-07-2015	Y	DB	736.98 ± 2.69	364.87 ± 4.49	915.32 ± 5.74	203.70 ± 4.24	6.33 ± 0.33	62.33 ± 0.33	62.00 ± 1.98	34.58 ± 1.43
	20-07-2015	Y	DB	814.91 ± 3.09	383.50 ± 3.11	1029.20 ± 7.71	230.05 ± 8.84	5.67 ± 0.33	56.00 ± 0.58	56.07 ± 3.24	32.15 ± 1.16

S3	21-05-2015	G	LB	588.89 ± 1.75	330.56 ± 2.23	788.14 ± 4.37	160.93 ± 4.27	8.67 ± 0.33	78.67 ± 4.81	77.90 ± 0.87	58.59 ± 0.44
	31-05-2015	G	LB	668.53 ± 1.20	375.59 ± 1.37	865.79 ± 4.98	176.36 ± 3.78	7.67 ± 0.33	73.00 ± 1.53	75.27 ± 0.11	53.39 ± 1.12
	10-06-2015	G	LB	760.86 ± 2.63	394.30 ± 2.74	1117.69 ± 5.51	193.72 ± 4.03	7.00 ± 0.58	68.67 ± 1.76	67.89 ± 0.95	43.92 ± 1.82
	20-06-2015	YG	B	964.53 ± 3.41	429.13 ± 2.07	1285.41 ± 3.84	238.68 ± 5.52	6.33 ± 0.67	62.33 ± 2.40	64.74 ± 1.27	41.76 ± 2.08
	30-06-2015	YG	B	998.81 ± 2.01	437.98 ± 0.98	1444.58 ± 10.40	255.06 ± 7.02	5.67 ± 0.33	57.67 ± 1.45	61.50 ± 1.08	37.04 ± 0.95
	10-07-2015	Y	DB	1134.56 ± 2.33	449.72 ± 1.49	1496.21 ± 4.29	274.23 ± 6.60	4.67 ± 0.33	48.67 ± 0.88	54.96 ± 1.32	33.98 ± 1.03
	20-07-2015	Y	DB	1194.01 ± 2.42	456.68 ± 2.59	1574.64 ± 7.30	278.99 ± 9.07	4.33 ± 0.33	43.00 ± 1.73	51.56 ± 0.97	30.55 ± 1.01
S4	21-05-2015	G	LB	588.74 ± 1.76	318.98 ± 3.42	788.76 ± 3.96	154.57 ± 2.88	8.67 ± 0.33	80.67 ± 3.53	76.63 ± 0.78	56.09 ± 2.12
	31-05-2015	G	LB	659.50 ± 3.18	337.94 ± 1.86	891.87 ± 9.77	164.39 ± 3.18	8.33 ± 0.33	73.00 ± 2.08	76.44 ± 0.58	50.04 ± 0.99
	10-06-2015	G	LB	740.62 ± 2.68	398.07 ± 2.44	1128.21 ± 14.46	178.71 ± 5.95	7.67 ± 0.67	67.33 ± 1.45	72.29 ± 1.31	47.98 ± 1.76
	20-06-2015	YG	B	804.25 ± 3.25	429.93 ± 3.63	1219.24 ± 10.97	214.22 ± 7.40	6.67 ± 0.33	53.33 ± 1.76	69.80 ± 0.55	44.92 ± 3.22
	30-06-2015	YG	B	1115.55 ± 3.38	434.44 ± 2.63	1407.28 ± 9.37	231.04 ± 6.03	6.00 ± 0.00	48.00 ± 2.65	62.17 ± 1.64	34.14 ± 2.31
	10-07-2015	Y	DB	1187.86 ± 3.75	449.50 ± 3.66	1517.32 ± 3.22	249.28 ± 5.87	5.33 ± 0.33	42.33 ± 1.86	57.37 ± 1.46	30.93 ± 0.17
	20-07-2015	Y	DB	1269.61 ± 3.34	465.66 ± 3.09	1610.30 ± 6.49	274.75 ± 3.43	4.00 ± 0.58	41.33 ± 2.03	51.26 ± 1.25	29.79 ± 0.40

G represents (Green), YG (Yellowish Green), Y (Yellow), LB (Light Brown), B (Brown) and DB (Dark Brown).

Table 3. Morphological Characters of Fruit/Seed in Year-2

Sites	Date of Collection	Colour		Size (mm²)		Weight of 100 Fruit/Seed (g)		Number of Fruit/Seed in 100g		Moisture content %	
		Fruit	Seed	Fruit	Seed	Fruit	Seed	Fruit	Seed	Fruit	Seed
S1	21-05-2016	G	LB	576.60 ± 1.42	320.82 ± 2.43	773.68 ± 3.08	156.79 ± 5.30	7.67 ± 0.33	80.00 ± 1.15	77.96 ± 1.09	60.58 ± 0.75
	31-05-2016	G	LB	644.77 ± 2.44	343.08 ± 1.58	826.92 ± 5.60	168.86 ± 11.12	6.67 ± 0.33	75.00 ± 1.53	75.76 ± 1.53	55.41 ± 1.83
	10-06-2016	G	LB	765.00 ± 1.84	449.91 ± 2.88	1006.98 ± 7.24	216.68 ± 5.05	6.00 ± 0.58	67.33 ± 2.73	72.30 ± 1.32	48.80 ± 1.85
	20-06-2016	YG	B	860.02 ± 1.86	451.59 ± 2.78	1181.93 ± 9.38	235.64 ± 5.85	5.67 ± 0.33	59.67 ± 1.45	68.22 ± 2.06	45.16 ± 2.53
	30-06-2016	YG	B	1120.17 ± 3.94	456.80 ± 1.94	1259.41 ± 6.53	245.51 ± 7.58	4.33 ± 0.33	55.33 ± 1.86	57.23 ± 2.74	40.09 ± 1.09
	10-07-2016	Y	DB	1196.72 ± 3.42	463.51 ± 1.25	1468.82 ± 4.26	254.93 ± 3.96	4.67 ± 0.33	48.33 ± 1.86	53.21 ± 2.06	33.75 ± 1.48
	20-07-2016	Y	DB	1290.58 ± 3.78	475.43 ± 3.50	1604.96 ± 3.86	276.84 ± 6.49	3.67 ± 0.33	42.00 ± 1.53	52.80 ± 0.50	30.65 ± 0.69
S2	21-05-2016	G	LB	440.30 ± 3.18	232.49 ± 2.12	641.27 ± 5.96	120.61 ± 2.42	14.33 ± 0.33	99.33 ± 1.45	78.05 ± 0.52	61.83 ± 2.07
	31-05-2016	G	LB	487.21 ± 5.78	241.69 ± 2.46	696.15 ± 2.97	135.52 ± 6.68	10.67 ± 0.33	94.33 ± 2.33	74.61 ± 1.30	50.91 ± 1.47
	10-06-2016	G	LB	565.53 ± 4.16	302.19 ± 2.66	787.44 ± 5.86	141.07 ± 9.30	9.33 ± 0.33	90.67 ± 2.33	72.06 ± 1.33	44.31 ± 0.95
	20-06-2016	YG	B	611.27 ± 4.82	325.93 ± 2.39	817.87 ± 8.04	155.72 ± 3.57	8.33 ± 0.33	78.33 ± 2.85	69.65 ± 0.50	41.17 ± 1.26
	30-06-2016	YG	B	694.13 ± 2.53	352.34 ± 3.01	877.24 ± 6.41	185.52 ± 7.23	8.00 ± 0.58	67.67 ± 1.45	65.85 ± 0.88	38.40 ± 0.54
	10-07-2016	Y	DB	793.32 ± 3.12	369.20 ± 1.91	941.92 ± 11.13	205.77 ± 5.41	6.67 ± 0.33	61.33 ± 1.20	61.34 ± 1.02	36.80 ± 2.31
	20-07-2016	Y	DB	828.77 ± 4.35	386.21 ± 3.71	1032.03 ± 7.54	231.57 ± 4.06	4.67 ± 0.33	55.67 ± 1.20	56.80 ± 0.68	31.23 ± 0.41
S3	21-05-2016	G	LB	558.53 ± 2.35	365.05 ± 2.17	788.35 ± 3.07	163.35 ± 2.18	7.67 ± 0.33	82.00 ± 2.52	77.85 ± 0.20	58.05 ± 0.25
	31-05-2016	G	LB	639.81 ± 2.25	393.55 ± 2.40	891.31 ± 6.32	179.74 ± 1.69	6.67 ± 0.33	73.67 ± 1.45	76.84 ± 0.69	54.18 ± 1.97
	10-06-2016	G	LB	698.54 ± 3.41	404.23 ± 3.42	1092.35 ± 5.35	191.99 ± 2.50	6.33 ± 0.33	67.00 ± 1.73	71.43 ± 1.03	45.12 ± 2.86
	20-06-2016	YG	B	921.54 ± 2.84	442.34 ± 2.78	1177.89 ± 8.52	228.26 ± 6.01	6.00 ± 0.58	65.67 ± 0.88	66.37 ± 1.65	39.02 ± 2.38
	30-06-2016	YG	B	989.16 ± 2.71	475.99 ± 2.05	1294.24 ± 6.41	272.40 ± 5.39	5.67 ± 0.33	58.67 ± 1.45	59.90 ± 1.34	35.83 ± 1.42
	10-07-2016	Y	DB	1147.67 ± 2.78	483.15 ± 1.31	1429.51 ± 11.33	274.38 ± 4.11	5.00 ± 0.58	53.33 ± 2.03	55.84 ± 1.49	32.01 ± 1.03
	20-07-2016	Y	DB	1206.69 ± 3.35	501.69 ± 1.59	1598.78 ± 6.92	294.67 ± 5.25	4.33 ± 0.33	47.67 ± 1.86	51.36 ± 1.99	30.60 ± 0.72
S4	21-05-2016	G	LB	550.65 ± 2.52	303.72 ± 3.75	788.37 ± 6.75	161.81 ± 3.39	8.33 ± 0.33	84.00 ± 2.31	76.79 ± 0.39	57.87 ± 0.44
	31-05-2016	G	LB	633.67 ± 2.31	397.54 ± 2.76	862.52 ± 5.63	177.16 ± 6.30	7.33 ± 0.33	73.67 ± 1.20	75.90 ± 1.92	54.94 ± 1.38
	10-06-2016	G	LB	742.53 ± 3.52	441.96 ± 3.23	1105.53 ± 6.95	185.07 ± 4.26	6.33 ± 0.33	70.33 ± 0.88	70.68 ± 0.86	47.62 ± 1.67
	20-06-2016	YG	B	807.22 ± 3.26	498.03 ± 3.31	1215.01 ± 8.26	216.80 ± 5.31	5.67 ± 0.33	64.33 ± 1.86	69.57 ± 1.20	43.12 ± 0.92
	30-06-2016	YG	B	1090.17 ± 2.33	504.42 ± 3.43	1510.04 ± 10.01	260.44 ± 5.44	5.00 ± 0.58	56.33 ± 2.03	64.13 ± 1.16	36.39 ± 1.68
	10-07-2016	Y	DB	1200.82 ± 3.33	547.70 ± 2.90	1597.67 ± 7.44	290.52 ± 5.92	4.33 ± 0.33	45.67 ± 2.85	54.89 ± 2.16	32.52 ± 0.64
	20-07-2016	Y	DB	1295.09 ± 2.30	591.49 ± 2.97	1633.24 ± 12.67	305.65 ± 6.48	3.67 ± 0.33	41.67 ± 1.45	50.23 ± 0.34	28.46 ± 0.77

G represents (Green), YG (Yellowish Green), Y (Yellow), LB (Light Brown), B (Brown) and DB (Dark Brown).

Table 4. Seed Moisture Content and Germination of the Stored Seed Yr- 1 and Yr-2

Year 1								
Months	S1		S2		S3		S4	
	SMC%	GER %	SMC%	GER %	SMC%	GER %	SMC%	GER %
Aug 2015	28.99 ± 1.43	0.00 ± 0.00	28.71 ± 0.67	0.00 ± 0.00	29.03 ± 2.14	0.00 ± 0.00	28.05 ± 0.76	1.33 ± 1.33
Sep 2015	27.03 ± 0.32	2.67 ± 1.33	26.03 ± 1.03	6.67 ± 2.67	28.41 ± 0.64	10.67 ± 5.81	27.28 ± 0.82	18.67 ± 4.81
Oct 2015	26.17 ± 0.60	12.00 ± 2.31	24.24 ± 0.62	20.00 ± 2.31	27.46 ± 1.84	29.33 ± 3.53	26.41 ± 0.95	29.33 ± 3.53
Nov 2015	24.68 ± 0.53	22.67 ± 3.53	23.09 ± 1.04	26.67 ± 1.33	26.83 ± 1.34	42.67 ± 3.53	25.26 ± 0.47	40.00 ± 2.31
Dec 2015	22.96 ± 2.31	33.33 ± 2.67	22.10 ± 0.29	37.33 ± 1.33	24.97 ± 0.11	44.00 ± 4.62	24.92 ± 0.21	41.33 ± 1.33
Jan 2015	22.18 ± 1.36	58.67 ± 5.81	21.31 ± 1.93	44.00 ± 2.31	22.64 ± 0.62	46.67 ± 1.33	23.97 ± 1.91	50.67 ± 4.81
Feb 2015	20.38 ± 0.43	61.33 ± 8.11	20.15 ± 2.40	49.33 ± 3.53	21.25 ± 0.67	60.00 ± 6.93	22.18 ± 1.36	62.67 ± 5.81
Mar 2015	19.43 ± 1.34	50.67 ± 3.53	19.99 ± 1.02	41.33 ± 2.67	20.53 ± 2.10	41.33 ± 3.53	20.38 ± 2.05	49.33 ± 4.81
Apr 2015	18.94 ± 1.78	24.00 ± 2.31	18.89 ± 1.60	21.33 ± 5.33	19.91 ± 0.18	32.00 ± 2.31	19.88 ± 0.94	25.33 ± 3.53
May 2015	**18.07 ± 1.27**	14.67 ± 3.53	18.30 ± 2.28	9.33 ± 3.53	18.14 ± 1.08	13.33 ± 3.53	18.73 ± 1.95	8.00 ± 2.31
Year 2								
Months	S1		S2		S3		S4	
	SMC%	GER %	SMC%	GER %	SMC%	GER %	SMC%	GER %
Aug 2016	29.51 ± 0.17	0.00 ± 0.00	28.41 ± 0.64	0.00 ± 0.00	29.24 ± 2.31	0.00 ± 0.00	28.43 ± 1.44	2.67 ± 1.33
Sep 2016	28.35 ± 0.52	4.00 ± 4.00	27.98 ± 0.70	4.00 ± 2.31	28.66 ± 0.18	9.33 ± 5.81	26.26 ± 1.35	9.33 ± 2.67
Oct 2016	27.33 ± 1.12	20.00 ± 4.62	26.50 ± 1.12	21.33 ± 3.53	27.77 ± 1.23	24.00 ± 2.31	25.44 ± 1.29	24.00 ± 2.31
Nov 2016	26.72 ± 3.30	32.00 ± 2.31	25.77 ± 2.46	38.67 ± 2.67	25.26 ± 0.82	34.67 ± 3.53	23.33 ± 1.75	32.00 ± 2.31
Dec 2016	24.85 ± 1.68	38.67 ± 3.53	23.55 ± 2.85	41.33 ± 4.81	23.48 ± 0.87	45.33 ± 4.81	20.90 ± 3.76	42.67 ± 3.53
Jan 2016	23.13 ± 2.95	54.67 ± 4.81	22.76 ± 1.00	45.33 ± 2.67	22.80 ± 0.31	48.00 ± 2.31	19.52 ± 0.67	48.00 ± 2.31
Feb 2016	22.46 ± 1.59	57.33 ± 1.33	22.55 ± 2.95	46.67 ± 3.53	21.87 ± 0.37	58.67 ± 3.53	19.25 ± 0.84	60.00 ± 2.31
Mar 2016	20.43 ± 1.67	45.33 ± 3.53	21.15 ± 2.52	44.00 ± 6.93	20.29 ± 1.12	45.33 ± 7.42	18.29 ± 1.08	45.33 ± 1.33
Apr 2016	19.68 ± 1.73	25.33 ± 1.33	20.61 ± 1.34	22.67 ± 2.67	19.95 ± 2.70	22.67 ± 4.81	18.19 ± 1.40	24.00 ± 6.11
May 2016	18.72 ± 2.89	10.67 ± 3.53	19.41 ± 1.00	12.00 ± 2.31	19.87 ± 1.17	10.67 ± 1.33	18.12 ± 1.08	13.33 ± 3.53

SMC % = Seed moisture content%, GER% = Germination % and S1, S2, S3, S4 represents Sites.

Discussion

In the Agriculture economy of India, oilseeds are important next only to food grains in terms of area, production and value (Hedge, 2012). Several oil seeds yielding plants of Horticulture and forest origin can play an important role for meeting the oil demand of the country. The apricot kernel oil can be considered as good edible oil and can be a viable option for meeting the oil demand of the hill region. A successful and profitable production is possible only through quality seeds production and availability. The quality of the seed is basically dependent on the metabolic and synthetic efficiency during seed development and maturation, which in turn is reflected upon the germination and vigorous growth of the resultant seedlings (Malarkodi and Srimathi, 2006). Seeds of wild apricot are dormant when they are collected and require 2-3 month stratification for germination (Martinez and Dicenta, 2001). According to Ghayyad et al., (2010); Martinez-Gomez and Dicenta, (2001); Mehanna and Martin, (1985); Pipinis et al., (2012) many *Prunus* species seeds have two different types of dormancy: internal or embryo dormancy and external or endocarp dormancy.

Physical characteristics of seed have played a significant role in determining the indices of seed maturity (Tewari et al., 2011). A relationship between colour change and germination has also been developed for five multipurpose species (Negi and Todaria, 1995), *Quercus leucotrichophora* (Bhatt and Ram, 2005), *Myrica esculenta* (Shah et al., 2010), *Bauhinia retusa* (Upadhyay et al., 2006), *Diploknema butyracea* (Singh et al., 2010) and *Prunus cerasoides* (Tewari et al., 2011) in the Central Himalayan tree species. William, (1985) have reported that change in colour of fruits provide a major criteria for judging maturation. A relationship was developed by Bonner, (1972) for *Plantanus occidentails* between seed colour and maturity which is used to identify physiological maturity of tree seeds. In the studied species fruit colour was changed (green to yellow) and not linked with germination.

According to Adams and Rinni, (1981) the decline in moisture content percentage is closely related to seed maturity. A study carried by Joshi, (2000) on *Dulburgia shisoo* shows that decreased in moisture content percent is a characteristic feature of maturation. Similarly present study also reveals that the moisture content percent declined with seed maturation. Singh and Kachari, (2006) reported that the germination percentage of seeds increased with decrease in moisture content percent for *Pinus kesiya* (Khasi Pine). Majeed et al., (2009) were also reported that the germination percentage of seeds increased with decrease

in moisture content percent in *Asculus indica.* Similarly in the present study germination percentage of seeds increased with decrease in moisture content percent.

Wani et al., (2017) have reported that the maximum weight of 100 seeds (stone) of *Prunus armenica* was 147.54g they have also report that the average length was 19.56mm and width was 15.50 mm (303.18 mm^2) these values are very close to present study. Wani and Mughal, (2017) have shown that the maximum germination percent was 60.33% which is similar to the germination recorded in the present study. The study carried out by Kumar and Shahnaz, (2013) showed that un-stratified seeds recorded maximum (72.24%) germination compared to stratified seeds (70.11%), whereas, per cent survival rate was higher (80.14%) in stratified seeds compared to un-stratified seeds (74.53%). The highest value of germination of the stored seeds (62.67 ± 5.81 %) of the present study was lower than these reported values. A study on *Jatropha carcus* carried out by Silva et al., (2012) have reported that green fruits had the maximum moisture content (76.0%) and started decreasing during the maturation of fruits and seed weight increases with the maturation. Similarly in the present study the fruits moisture content was maximum in the initial stage (green fruits), which is decreased with the maturation and seed weight increased with the maturation.

The present study shows that the moisture content percent appears to be important character for assessing the seed maturity of the *Prunus armenica*. Change in fruit/seed colour of the species was an indicator of exact time of fruit collection but unrelated to germination. Assessing the exact time of seed maturation is important for the collection as well as storage of seeds for its better regeneration, conservation, development, growth, management of a species and its adaptation in changing climatic conditions.

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