

Physio-morphological Indices of Seed Maturity in Aswagandha [*Withania somnifera* (L.) Dunal]

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ABSTRACT Physiological maturity and harvesting time are the major considerations in the production of quality seeds. Experimental studies were conducted at IARI, New Delhi during late *kharif* of 2007-08 to identify physiological maturation and optimum duration for the harvest of the quality seeds. A minimum of 100 flowers a day were tagged, every alternate day from 0 day to 60 days from anthesis. Seed berries were harvested at periodic interval of two days starting from 02 day to 60 days, and were used for berry and other seed quality parameters. The results showed that seeds attained physiological maturity at 40-44 days from anthesis with the physio-morphological indices of maximal fresh and dry weight of seed, berry size and visual indices such as turning of berry to red colour. Seed attained germinability on 32 days from anthesis.

Key words: Aswagandha, berry, seed quality, physiological maturity

The demand for medicinal plants has increased globally due to the resurgence of interest in and acceptance of herbal medicine [1]. Ashwagandha [*Withania somnifera* (L.) Dunal], one of the important medicinal plants, known as Indian ginseng, used in ayurvedic medicine, is a small or middle-size shrub (about 30 cm to 1.5 m in height), erect, greyish, branching with perennial or annual habit and flowering nearly throughout the year. Physiological maturity and harvesting time are the major considerations in the production of quality seeds. Seed maturation refers to morphological, physiological and functional changes in seeds that occur from time of fertilization until the seeds are ready for harvest. No systematic studies on morphological indices or seed physiological maturity has been reported in ashwagandha species, hence the present studies were undertaken to study the seed quality attributes.

MATERIALS AND METHODS

For determining the physiological maturity of

seeds the crop was raised from selected seeds of previous available crop (red seeded berries) at experimental plots in Division of Seed Science and Technology, Indian Agricultural Research Institute (IARI), New Delhi, during late *kharif* of 2007-08. The plants were spaced at 60 cm x 30 cm distance in rows of 5 x 5 m plots. To study the stages of seed development and maturation a minimum of 100-flowers a day, every alternate day from 02 day to 60 days from anthesis (DFA), were tagged. Seed berries were harvested at periodic interval of two days starting from 02 day to 60 days. Fifty berries in the batches of 10 berries in five replicates were collected and used for berry and seed quality parameters. Berries and the seeds were stored in brown-paper bags under ambient temperature of New Delhi until use.

Berry and seed quality parameters

For determining the fresh and dry weight of berries, 50 berries in batches of 10 x 5 replicates were weighed afresh and dried at 70°C for 48h

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in an electrical oven. Simultaneously, 50 more berries were collected at each periodic interval for studies on seed and its quality parameters. The berries were hand shelled and seeds obtained were dried in ambient temperature for two days and used for other studies. Berry and seed quality parameters studied were as under:

- i) Colour of the berries (green, yellowish-green and red)
- ii) Diameter of berries (mm)
- iii) Fresh weight of berry harvested at different stages (02 to 60 DFA)
- iv) Dry weight of berry
- v) Number of seeds per berry
- vi) Thousand seed weight (both for fresh and dry seed) following procedure of Agrawal & Singh [2] and
- vii) Germination percentage following procedure of Pandiyaraj [3].

RESULTS AND DISCUSSIONS

Full viability and germination of seed cannot be attained until the seed reaches full maturity [4, 5]. Seed maturation refers to morphological, physiological and functional changes that occur from the time of fertilization until seeds are ready for harvest. Therefore, it was desirable to know at what stage of the berry seeds attains physiological maturity in ashwagandha.

Results on fresh and dry weight of berry in relation to different stages of maturity in ashwagandha are given (Table 1). ANOVA based on observations from 50 berries in batches of 10 x 5 replicates during day 02 to day 60 from anthesis (DFA) indicate that the fresh weight attained by berries were at par among 02 to 14 days; 16 to 40 days and 42 to 60 days; whereas, dry weights at par from 40 to 60 DFA (Table 1). It is inferred from the experiment that ashwagandha berries attain physiological maturity during 40 to 42 DFA (Table 1). These results were further confirmed based on other berry and/or seed quality parameters in relation to different stages of maturity (Table 2). Berry colour was green from day 01 to 38 days; turn yellowish-green on 40 DFA and finally become red 42 DFA

Table 1. Fresh and dry weight of ashwagandha berry in relation to stages of maturity (2007-08)

Days from anthesis	Berry fresh weight*(mg)	Berry dry weight*(mg)
2	0.620	0.058
4	1.111	0.142
6	1.974	0.282
8	3.014	0.519
10	4.575	0.915
12	6.733	1.449
14	9.027	2.101
16	9.852	2.351
18	10.395	2.650
20	11.271	2.954
22	11.414	3.061
24	11.694	3.234
26	11.832	3.366
28	12.085	3.545
30	12.204	3.811
32	12.431	4.085
34	12.518	4.201
36	12.670	4.347
38	12.737	4.545
40	12.922	4.693
42	13.124	4.755
44	13.386	4.941
46	13.184	5.134
48	13.190	4.847
50	13.149	4.816
52	13.078	4.848
54	13.296	4.925
56	13.128	4.979
58	13.050	4.862
60	13.145	4.956
CD (5%)	0.472	0.548

* Berry weight is the mean value of five replicates from ten berries in each replicate

onwards up to 60 days from anthesis. Changes in ashwagandha berry colour are suggestive of their physiological maturity. Fresh berry diameter (mm), based on observation in 50 berries in batches of 10 x 5 replicates, registered a steady increase from 17 to 20.1 mm between 32 to 40 DFA; and further increased to 21.6 mm on 42 DFA (Table 2). Berry diameter of 20.6 mm (on 42 DFA) was statistically on par with other berry diameters (on 42 to 52 DFA). Results further confirm the physiological maturity of ashwagandha berry on the basis of its diameter on 42 DFA (Table 2).

Seeds of ashwagandha were small and alike brinjal morphologically, another member of solanaceous family. Seed development in ashwagandha though commenced on 01 DFA to physiological maturity, morphologically developed seeds were obtained on 16 DFA onwards. Number of seeds per berry increased from 38 to 41

(during 32 to 40 DFA), decreased marginally to 39 (during 42 to 52 DFA). Initial increase in seed number per berry followed by a marginal decrease in seed number is a common phenomenon and happens due to some embryo abortion during seed development. Optimum number of seeds per berry was 40-41 on 40 DFA, suggestive of physiological maturity of seeds on 40 DFA. Constant 1000-seed weight both, for fresh and dry weight of a crop species was also suggestive of its physiological maturity in nature. Ashwagandha seeds attain their optimum dry weight on 44 DFA, which was at par with seed weight obtained from berries on 40 to 52 DFA (Table 2). Seed moisture contents attained during physiological maturity was in the range of 23.7 to 25.1 per cent. Coincidence of physiological maturation with morphological indices for maximum seed size, dry weight accumulation and change of seed coat colour (from green to brown)

Table 2. Berry and seed quality parameters in relation to stages of maturity in aswagandha (2007-08)

Days from anthesis	Berry colour	Diameter (mm)	No of seeds/ berry	1000-seed weight (g)*		Germination** (%)
				Fresh weight	Dry weight	
32	Green	17.09	39.66	1.48	0.75	30(33.18)
34	Green	18.30	41.40	1.50	0.80	50(45.00)
36	Green	19.30	38.92	1.54	0.88	68(55.69)
38	Green	19.80	38.92	1.55	0.96	75(60.24)
40	Yellowish-green	20.10	41.98	1.59	1.06	82(65.14)
42	Red	21.60	40.76	1.59	1.09	85(67.30)
44	Red	21.80	39.96	1.48	1.13	88(70.11)
46	Red	22.36	40.70	1.61	1.20	87(68.96)
48	Red	22.41	41.98	1.61	1.20	99(71.03)
50	Red	22.49	40.32	1.61	1.21	88(69.89)
52	Red	22.56	39.96	1.62	1.21	89(71.03)
CD (5%)		1.37	2.65	0.10	0.14	6.30

* Determined following procedure of Agrawal & Singh [2]

** Germination percentages are written as mean from four replicates; values in paranthesis were arc sine transformed values.

was observed in chilli [6]. Maximal viability and vigour was reported at physiological maturity in brinjal [7] and in mungbean [8] as an index of maturation [9]; and better seed quality in chilli on 35 to 41 DFA [10]. Similar results were reported in attaining maximum fruit length in chilli on 35 DFA which decreased thereafter [6]; physiological maturity and highest seed quality attributes in Indian mustard [11]; and attaining physiological maturity in *Crotalaria* on 40-50 DFA with maximum germination, vigour and viability [12]. ANOVA based on the above observations of seed and berry quality parameters suggest that ashwagandha seeds attain physiological maturity between 40 to 44 days from anthesis. There was a steady increase in seed germination percentage from 32 to 40 DFA (recorded on every 2 day interval) and registered higher germination value (89%) on 52 DFA (Table 2); indicating that fresh seed in ashwagandha crop raised at IARI experimental plots under Delhi conditions (August 2007-April 2008 harvested seeds) did not exhibits any dormancy. Whereas, seed lots procured from elsewhere in the country, registered dormancy.

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