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Standardization of seed and seedling standards of phalsa (*Grewia subinaequalis* L.)

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Abstract

Phalsa multiplication through seeds requires certain prerequisites *i.e.* fully ripened fruits and freshly extracted seeds for seedling raising, portrays for maximum seed germination per cent, germination more than 80 % from fresh seeds and completed within 25 days after sowing with 60-90 per cent plant survival rate, during seedlings shifting in polybags require minimum 3-4 weeks period with height of about 4-5 cm, seedlings of about 3-4 months age group attaining height and diameter 35-40 and 0.25-0.35 cm, respectively ready for sale or field planting. The developed standards would be highly useful for conservation of elite type germplasm and large scale multiplication of seedlings of phalsa.

Key words: Phalsa, seed propagation, seed standards, seedling standards

Introduction

Phalsa (*Grewia subinaequalis* L.) is known to be one of the oldest indigenous fruits in country. It is widely distributed in tropical and subtropical regions of India, Pakistan and Bangladesh. Phalsa is grown commercially in several states *i.e.* Punjab, Uttar Pradesh, Madhya Pradesh, Haryana, Rajasthan and the Himalayan regions, and at smaller scale in Karnataka, Maharashtra, Andhra Pradesh, Gujarat, West Bengal and Bihar. It is found up to 3,000 feet above sea level. Phalsa is drought-hardy crop and thus suitable for arid and semi-arid zones. It comes under underutilized fruit crops but have nutritional and medicinal value. The nutritional and medicinal value of phalsa is due to its high phenolic compounds, antioxidants, organic acids, tannins, anthocyanins, and flavonoids present in it (Kumar and Haldhar, 2020). Phalsa fruits have several traditional health benefits. It is an astringent, coolant and stomachic in nature. During Vedic period, the bark was used as a demulcent and serves as a treatment for rheumatism. Ground leaves is used to treat pustular infections and possess strong antimicrobial and antibacterial properties capable of remedying *Escherichia coli*. Its fruit and leaves exhibited significant anticancer activities against breast cancer cells and liver cancer cells (Kumar and Saravanan, 2017). Despite the highly nutritional value of the fruit, its commercial scale cultivation and production did not receive a fair response from the industry. Traditionally, it is cultivated as subsistence farming and hence it is mostly consumed in fresh fruits and juices. In India, ripen fresh fruits consumed during summer months and also preparation of refreshing cool beverage (Kumar and Haldhar, 2019). For fruit and colour development, fruit ripening and quality it requires optimum sunlight and warm temperatures.

Phalsa can grow and thrive well in different types of soils. However, sandy loam soil having good drainage facility is ideal for good growth and development of the plant. It is an ideal plant for multi-story cropping. However, its popularity is restricted owing to highly perishable nature, small size of fruit and non-synchronous maturity, which necessitates repeated harvesting. Therefore, the plantation is mainly confined to the surroundings of big cities. Its cultivation is also possible with the minimum or no use of synthetic chemical nutrients that also has a sustainable effect on environment and the soil. Good quality and healthy planting materials is the key of a successful orcharding which is lacking in phalsa. The demand for quality planting material of phalsa is increased throughout the country in the recent years. However, the greatest bottleneck in the expansion of area under it is the non-availability of genuine and named plants of released variety in adequate quantity from reliable government nurseries. The ICAR-CIAH, Bikaner has identified Thar Pragati an improved of phalsa for cultivation in arid and semi-arid region. More often farmers have to get the plants from unreliable sources and this practice is causing great harm to the fruit industry. The maintenance of purity is easy in vegetatively propagated plants as compared to seed propagated ones, still it requires a close monitoring at different stages in the nursery to produce disease and pest free planting material. (Anonymous, 2019). For improving this crop, selection of high yielding genotypes with desirable characters from seedling population and perpetuation by vegetative means is the best strategy.

There is not much attention given to the phalsa improvement by research institutes and state agricultural universities. Thus, there is no better variety available for commercial cultivation of phalsa. From last twenty years at ICAR-CIAH, Bikaner collection, conservation and evaluation of several genotypes under field condition have been done.

These genotypes have variations in plant, stem, leaf, flower, fruit size and color *etc.* which have collected from different states of the country and on which continuous research and evaluation was done for good quality and high yield production (Kamlesh and Haldhar, 2019). Results of several years of continuous study one elite genotype 'CIAH-P-1 was identified at institute level based on big fruit size, high fruit yield potential and other desirable attributes for commercial exploitation which is capable of producing high yields in limited resources in hot dry climate. Propagation of phalsa by seeds and cuttings has been practiced since long time, but till date this crop commercially multiplying through seeds (Sarolia *et al.*, 2018) only due to easy in propagation and short juvenility. General practice for seed propagation, seeds should be sown in June month at 1.5-2.0 cm deep in poly bags filled with equal proportion of FYM and soil. Success of germination depends on number of factors *i.e.*, water management, plant protection and bird-pest management etc. In summer, these are very difficult and reduce the success rate drastically. In place of this portray with soil less media provide the better option and ensure success as compared to direct polybags sowing. This fruit crop has good production potential but still underutilized and yet requires commercial exploitation. Additionally, meagre information are available on seed/ planting material standards till date in most of the underutilized fruit crops and no commercial exploitation for value added products for consumer preference.

Thus, keeping of above points in mind present study was undertaken to develop seed and seedling material standards of phalsa for high quality production. Seed and seedling material standards of phalsa cultivar 'CIAH-P-1' were standardized in the present study. The developed standards would be highly useful for conservation of elite type and large scale multiplication of quality planting material of phalsa for commercial orcharding in the country.

Materials and Methods

The experiment was conducted during 2019 at nursery unit, ICAR-Central Institute for arid Horticulture, Bikaner which is located at 28° N latitude, 73° 18° E longitude and at altitude of 234.84 m above sea level. Phalsa mature fruits have attractive and red to dark purple in colour were plucked manually from elite genotype CIAH-P-1 (IC No. 0628132) during May month and categorized on the basis of size (<8.5, 8.6-9.8 & > 9.9 cm) and weight (<0.4, 0.41-0.49 & ≥0.5 g) in A, B and C grades, respectively then removed pulp by gently messing in water dip. Immature, undersized, shriveled and off type seeds removed and minimum of 400 seeds were taken and treated with carbendazim 3g per kg of seeds and sown in ten plug trays containing 40 cells (100 cc) in each in June month. Protray containing media mixture of vermiculite, perlite and cocopeat in the ratio of 1:1:2, respectively. These portrays were kept under agro-shed net (50% intensity) conditions and followed uniform management practices *viz.*, watering, plant protection, nutrition's management *etc.* Similarly, in polybags directly sown seed containing media of FYM, pond silts and soil in ratio of 1:1:2, respectively. Observations were recorded pre germination as fruit size, weight, seed size, seed weight, seed number per gram, test weight (1000 seed weight), per cent germination. Post emergence of seedling picked at four leaf stage and shifted in poly bags containing media FYM: pond silt and soil in the ratio of 1:1:2, respectively. Seedling parameters *viz.*, seedling height, seedling diameter, leaf number, internodal length, root length, seedling vigour, biomass of seedlings were observed at 25 days interval up to 100 days after sowing as per standard methodology. Further, seedling vigour index was calculated by the formula proposed by Abdul and Anderson (1973) *i.e.* averaged root length (cm) + averaged shoot length (cm) x survival percentage in polybags conditions. Data were analysed with one factors analysis using statistical online OPSTAT software developed by Sheoran *et al.* (1998).

Results and Discussion

Fruit and seed attributes

Data revealed that mature fruits (diameter and weight), seed parameters (size, weight g^{-1} and test weight) and germination parameters (per cent and span) significantly varied with grade of fruits and growing conditions. General fruit diameter ranges from 8.03-9.98 mm polar to 8.44-10.78 mm equatorial whereas, seed length slightly bigger 4.94-5.84 mm than breadth 3.61-4.38 mm. Seed weight in all categories recorded about 0.04-0.05 g weight of individual fruit. Per gram of weight counted seed 18 in A-grade and 22 in C grade fruits further, test weight varies with 48.8 to 52.6 g. Germination of seed initiation starts within fortnight after seed sowing observed *i.e.*, on 15th day and 50 % germination achieved on 20th day of sowing and final count was recorded on 25th days after sowing in both the conditions. Portray sown seeds germinated somewhat earlier than polybags might be due to cocopeat based media containing good water holding capacity and aeration that favoured better air exchange to faster germination. Additionally fresh seed sown were recorded maximum seed germination (> 80-90 %) over stored (one year) one (≤ 50 %) at ambient temperature. Stored fruit highly damaged by mould growth and quickly shriveled pulp on seed or hard seediness cause poor germination within a month period. This probably due to seed moisture, storage temperature and viability has a strong relationship, seed maintain moisture more than 12 per cent (12-16%) during the defined storage environment have considerable viability (Table 1).

Seedlings attributes under protrays grown than shifted to polybags

Seedlings have four leaf stage, 5-6 cm length and 20-25 days old, ready for shifting for secondary hardening in polybags. Seedlings parameters gradually showed increasing trend with the advancement of the days after shifting or sowing (DAS) in polybag. An interesting trend was observed when compared the seedling parameters over successive days of seedling growth. The minimum per cent increase was

observed during 0 to 25 days after shifting over rest of the segments in plant height, diameter, root length, seedling vigour *etc*. As far as seedling parameters under polybags seed sowing is concerned recorded same trend but lower incremental rate over portrays conditions. In present study 0-25 DAS showed low incremental might be due to changing of media (portray to polybags) and little damage of roots during handling and shifting, but after that shifted seedlings got required environment for accelerating growth and development of seedlings over polybags conditions. These results are in accordance with the findings of Davis and Hartmann (1984) and Hartmann *et al*. (2002). In present study maximum seedling height (40.17 cm), diameter (2.9 mm) and inter nodal length (3.4 cm) at 100th DAS might be due to better uptake of moisture which played key role in enhancement of vigour index in poly bag shifted seedlings from protray conditions (Table 2). This is in line with the results of Jabbar *et al*. (2010).

Seedlings parameters directly sown under polybags conditions

Seedling parameters in directly seed sown in polybags conditions were shown significantly with advancement of DAS. The initial observations (25 DAS) were recorded on seedling height 2.46 cm, diameter 0.34 mm, number of leaves 3.4, internodal length 1.15 cm, root length 4.11 cm and survivability 67 per cent. At 100th DAS the respective values were, 35.2 cm, 2.51 mm, 11.0, 3.30 cm, 28.60 and 62.3 %, respectively.

Seedling parameters between both the conditions (portray sown and then shifted in polybags and directly seed sown in polybags), portray to polybags shifted seedlings were better with regards to growth, vigour and survivability during different days after sowing. At 100th DAS the portray sown seed shifted in polybags treatment recorded higher plant height 14.12 %, seedling diameter 15.54 %, seedling vigour 25.16 % and survivability 30.82 % over direct seed sown in polybags condition. This early attainment in portray sown and shifting seedlings polybags might be due to favourable growing conditions, better aeration and optimum moisture retention during experimental period. *I*t is proved that portray seedlings are more stout and vigorous due to easy management and produce more volume of roots and less chance of soil born diseases as well as can be harvest the benefit of secondary nursery (Anonymous, 2019).

Therefore, on the findings from the study seed and seedlings standards have developed and phalsa requires prerequisites for quality production such as (1) seeds should have test weight around 50 g (20 seeds per gram), (2) seed germination should be more than 80 per cent with 60-90 percent plant survival rate, (3) seedlings should be ready for shifting in polybags within 20-25 days from seed sowing, and (4) seedlings of about 3-4 months age group attaining height and diameter 35-40 and 0.25-0.35 cm respectively ready for sale or field planting (Fig. 1).

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Table1. Fruit/seed parameters and germination status of phalsa

Grades	Fruit diameter (mm)		Seed size (mm)		Fruit weight (g)	Seed weight (g)	Number of seed (g^{-1})	Test weight (g)	Germination (%)		Germination span (days)	
	Polar	Equatorial	Length	Breath					PT	PB	PT	PB
A	9.98	10.78	5.84	4.38	0.50	0.05	18	52.6	95.6	84.5	14.0	18.0
B	9.06	9.67	4.96	4.40	0.44	0.05	20	51.5	95.0	85.0	14.3	18.3
C	8.03	8.44	4.94	3.61	0.35	0.04	22	48.8	93.3	82.7	16.0	21.0
SEm±	0.14	0.15	0.13	0.18	0.13	0.01	0.79	1.90	0.93	0.57	0.31	0.58
CD at 5%	0.43	0.44	0.40	0.54	0.40	NS	2.38	NS	NS	1.72	0.92	1.72

Where, PT:Protray and PB:Polybag

Table 2. Seedling parameters of phalsa sown in portrays conditions

Days after Sowing	Plant height (cm)	Seedling diameter (mm)	Number of leaves	Inter-nodal length (cm)	Root length (cm)	Root: Shoot	Seedling vigour index	Seedlin g biomass (g)	Survival (%)
25	5.23	0.78	4	1.3	8.11	1.55	631	3.50	87.5
50	8.55	1.16	6	1.4	9.00	1.05	830	4.88	83.0
75	27.33	2.15	10	2.6	18.11	0.66	2149	12.77	82.3
100	40.17	2.90	12.4	3.4	30.80	0.77	3358	20.10	81.5
SEm±	2.22	0.28	0.53	0.19	1.44	0.01	38.65	0.36	0.61
CD at 5%	6.72	0.86	1.59	0.59	4.34	0.28	117.78	1.10	1.85

Table 3. Seedling parameters of phalsa sown in polybags conditions

Days after sowing	Plant height (cm)	Seedling diameter (mm)	Number of leaves	Inter -nodal length (cm)	Root length (cm)	Root: Shoot	Seedling vigour index	Seedling biomass (g)	Survival (%)
25	2.46	0.34	3.4	1.15	4.11	1.67	276	2.24	67.0
50	7.72	0.68	5.5	1.50	7.51	0.97	497	5.54	65.3
75	16.05	1.57	8.0	1.70	11.35	0.71	1152	9.15	64.0
100	35.20	2.51	11.0	3.30	28.60	0.81	2683	14.00	62.3
SEm±	0.49	0.09	0.60	0.10	1.19	0.07	56.18	0.63	1.23
CD 5%	1.50	0.26	1.79	0.31	3.57	0.21	168.21	1.88	3.69

Seed and seedling standard of phalsa

S. No.	Character	Standard
1.	Stage of fruit	Fully ripe
2.	Period of fruit ripening	May
3.	Fruit condition for seedling raising	Fresh and stored seed
4.	Seed extraction	Manually by running water
5.	Seed storage condition	Cool and dry place
6.	Seed viability during storage (month)	12-14
7.	Test weight (g)	49- 53
8.	Seed sowing	Protray
9.	Germination media	Cocopeat and FYM based
10.	Protray/ root trainer media mixture	Cocopeat: vermiculite (2:1) in portray and soil:pond silt : FYM (2:1:1) in polybags
11.	Germination initiation after sowing	12-15 days
12.	Germination 50%	18-20 days
13.	Germination > 95%	21-25 days
14.	Germination (%)	80-95
15.	Age of seedling suitable for shifting	3- 4 weeks
16.	Height and stage of seedling suitable for shifting	4-5 cm at four leaf stage
17.	Seedlings ready for sale/ f ield planting	3-4 months from seed sowing
18.	Height of standard seedlings at 3 -4 months (cm)	35-40
19.	Diameter of standard seedlings 3 -4 months (cm)	0.25-0.35

Direct polybag sown | Protray sown | Seedlings ready for sale

Fig. 1. Experimental view of phalsa and saplings ready for plantation

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