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# Effect of Harvesting Stages and Post Harvest Ripening on Seed Yield and Seed Quality of Bottle Gourd var. ABG-1

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**ABSTRACT:** An experiment was carried out to investigate the effect of stage of harvest and post harvest ripening on seed yield and quality of bottle gourd cv. ABG-1 during *kharif* 2014-15. The treatments consisted of three stages of fruit harvest (40, 50 and 60 days after anthesis), three post harvest ripening (PHR) periods (10, 20 and 30 days) and their combinations. Significant increase in fruit length, fruit width, number of filled seed per fruit, seed weight per fruit, seed yield per vine and seed yield per ha were noticed in the fruits harvested at 60 DAA. However, the seed quality parameters were significantly higher in 50 DAA for germination percentage, seedling length, seedling fresh weight, seedling dry weight, vigour index-I, and vigour index-II. The significantly higher seed quality parameters were observed at 20 days of post harvest ripening (PHR) as compared to other treatments. Effect of harvesting stages at 50 DAA and PHR of 20 days gave higher seed yield and seed quality. Hence, it is concluded that Bottle gourd cv. ABG-1 should be harvested at 50 DAA and 20 days PHR for obtaining better quality seeds.

**Key words:** Bottle gourd, Harvesting stages, Post harvest ripening, Seed extraction, Seed yield and Seed quality

Bottle gourd (*Lagenaria siceraria* (Molina) Standl) is an important cucurbitaceous vegetable crop grown for its fleshy fruits in tropical and subtropical regions. It is cultivated both in *kharif* and summer season in western part of the country, whereas in tropical regions it is cultivated round the year under mild temperature conditions. It is grown for tender fruits which are used in several culinary preparations. India is the second largest producer of vegetables in the world next to China, with the production of 162187 thousand MT [1]. Vegetable cultivation presently occupies 7.98 million ha area and accounts for 5.49 per cent of the cultivated area of the country which is very low in view of the total vegetable requirement to suffice the recommended quantity of vegetables per day per head. The average productivity of vegetable crop in the country *i.e.*, 16 tonnes per ha is considerably lower than the average productivity of China (18.75 tonnes) and USA (28.56 tonnes). Bottle gourd is grown in India in an area of 11.09 thousand hectare with an annual production of about 2186.20 MT having 18.07 MT per hectare productivity [2]. It's fruit juice is considered good for preventing heart-related health problems and it helps in maintaining better blood circulation. The bottle gourd fruits develop and attain physiological maturity non-uniformly 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 [3]. The contribution of seed coat to seed weight and contribution of cotyledon to seed weight and their ratio were found to change significantly during physiological maturity [4]. Rural farmers in the villages generally harvest the bottle gourd fruits at once, after complete senescence of the plant. Because of the varied fruiting nature, all the fruits do not reach maturity before the senescence of plant, resulting

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in a mixing of mature and immature seeds after harvest [5], causing low germination rate, poor plant stand and ultimately poor seed yield. Postharvest storage of fruits improves germinability in many cucurbits. It is also argued that seeds obtained from fruits harvested even before attainment of physiological maturity and allowed for postharvest fruit ripening for few days may also produce good quality seeds in cucumber because the development of seed continues in fleshy fruits owing to continuous supply of nutrients and food reserve from fruit to seed [6]. There is no authentic and well worked out seed production practice such as standardized harvesting stage or post harvest ripening and also, their impact on seed yield and quality of bottle gourd has not been worked out. Based on the above facts, it is necessitated to develop suitable seed production technology for bottle gourd variety ABG-1.

## MATERIALS AND METHODS

The field experiment on quality seed production of bottle gourd cv. ABG-1 was conducted at Main Vegetable Research Station, AAU, Anand, Gujarat during *Kharif* 2014-15. The fruits were harvested at three different stage, *viz.*, H1: 40 days after anthesis (40 DAA), H2: 50 days after anthesis (50 DAA), and H3: 60 days after anthesis (60 DAA). The fruits harvested from each stage were kept in storage for post harvest ripening for a period of 10, 20 and 30 (R1, R2 and R3 respectively) days, later these fruits were used for recording average fruit weight, length and width. The seeds were extracted manually from each of the nine treatments and subjected to sun drying for a period of 48-72 h. After drying, average number of filled and non-filled seed per fruit, seed weight per fruit, 100-seed weight, seed yield per vine, seed yield per plot, seed yield per ha and seed quality parameters were recorded from five randomly selected fruits.

### *Germination test*

The germination tests were conducted as per ISTA procedure by adopting "Between Paper (BP)" method. Freshly harvested 100 seeds in three replications were taken at random from the seed lot of each treatment and placed uniformly on germination paper. The rolled towels were kept in germinator, where the temperature was maintained at 25 ± 0.5°C and the relative humidity at 95 ± 1 per cent.

### *Seedling length (cm)*

Ten normal seedlings were selected at random from the germination test on the day of final count. The length between the collar region and the tip of the primary shoot was measured as shoot length (cm). The length between the collar region and the tip of primary root was measured as root length (cm). The seedling length was computed by using the following formula,

Seedling length (cm) = Shoot length (cm) + Root length (cm)

### *Seedling fresh weight (mg)*

To record seedling fresh weight, ten seedlings were counted, cut free from their cotyledon and weight was recorded while still moist.

### *Seedling dry weight (mg)*

The ten normal seedlings selected randomly from the germination test, were dried in butter paper packets in hot air oven at 80° ± 1° C for 24 hours. Thereafter, the seedlings were weighed on an electronic balance. The weight of the dried seedlings was recorded and dry weight per seedling was calculated and expressed in miligram [7].

### *Vigour indices*

The vigour indices were calculated using the procedure suggested by [1] and expressed as whole number.

Vigour Index-I = Germination (%) X Seedling length (cm)

Vigour Index-II = Germination (%) X Seedling dry weight (mg)

### *Electrical conductivity*

For measuring the electrical conductivity, three replicates of 50 seeds each were soaked in 250 ml of deionized water at 25 ± 0.5°C for 24 hours. The seed leachate was collected and the

conductivity was measured with the help of digital conductivity meter along with deionized water as a control [9]. The data were subjected to analysis by factorial RBD with three replications.

Statistical model:

$Y_{ij(k)} = \mu + R_i + A_j + B_k + (AB)_{jk} + \varepsilon_{ijk}$

$i = 1, 2, \ldots, r \quad j = 1, 2, \ldots, a \quad k = 1, 2, \ldots, b$

where,

$Y_{ijk}$= Response of the $i^{th}$ unit receiving $j^{th}$ factor A and $k^{th}$ factor B

$\mu$ = General mean

$R_i$ = Effect of $i^{th}$ replication

$A_j$ = Effect of $j^{th}$ factor A

$B_k$ = Effect of $k^{th}$ factor B

$\varepsilon_{ijk}$ = Uncontrolled variation associated with $j^{th}$ factor A and $k^{th}$ factor B in $i^{th}$ replication

## RESULT AND DISCUSSION

*Effect of harvesting Stages on seed yield attributes*

The present experiment study showed that, harvesting stages had significant effect on all the fruit and seed parameters assessed. The fruit length (64.52cm), fruit width (8.55cm), number of filled seed per fruit (311.89), seed weight per fruit (49.94g), seed yield per vine (311.71g), seed yield per plot (3.12kg) and seed yield per ha (1558.86 kg) were noticed to be higher in the fruits harvested at 60 DAA. However, maximum fruit weight (2.41kg) and 100 seed weight (14.60g) were observed in the fruits harvested at 50 DAA (Table 1). This may be because seed development is completed even at 50 DAA on account of continuous supply and accumulation of metabolites (food reserves) from mother plant to these sinks. These results are in conformity with the reports of Biradar, [3] and Babu *et al.*[9] in brinjal. The fruits harvested at 40 DAA were having minimum fruit length, which may be due to more number of immature, small and underdeveloped fruits. Fruits harvested at 60 DAA had maximum fruit length and more number of mature fruits.

*Effect of harvesting stages on seed quality attributes*

Significantly higher germination percentage (80.11%), seedling length (25.26cm), seedling fresh weight (7722.22 mg), seedling dry weight (302.44 mg), vigour index-I (2028) and vigour index-II (24256) were recorded when fruits were harvested at 50 DAA and minimum electrical conductivity (0.398 µmhos/cm/g) was noticed in the fruits harvested at 60 DAA (Table 2). 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 and water soluble proteins in the seeds. On the contrary, seed germination percentage was low in early harvested fruits due to presence of large number of immature and under developed seeds with lesser food reserves and nutrients in the seeds [10].

*Effect of post harvest ripening on seed yield attributes*

It is assumed that even after harvest of fruits, development and maturity of seeds continues, while still enclosed within the fruits beacuse there would be transfer of food reserves to seeds from the pulp in fleshy fruit crops. Hence, ripening period of fruits after harvest may enhance the seed quality parameters. Highest fruit weight (2.32kg) was noticed with 20 PHR, maximum number of filled seeds per fruit (256.68) was noticed in 30 PHR and minimum number of unfilled seeds per fruit (51.52) was noticed with 30 PHR (Table 1). These results are in agreement with the results of [9] and [11].

*Effect of post harvest ripening on seed quality attributes*

Significantly higher germination percentage (69.44%), seedling length (24.22cm), seedling fresh weight (7500 mg) and vigour index-I (1707) were noticed with 20 PHR and highest electrical conductivity (0.450µmhos/cm/g) was noticed with 10 PHR. This might be due to better development of seeds at 20 PHR, on account of greater accumulation of food reserves in the seeds resulting in higher vigour and germinability as per the results of [6] and [12].

**Table 1. Fruit and seed yield parameters as influenced by harvesting stages and post-harvest ripening in bottle gourd cv. ABG-1.**

| Treatment | Fruit length (cm) | Fruit weight (kg) | Fruit width (cm) | No. of filled seeds/ fruit | No. of unfilled seeds/ fruit | 100-seed weight/ fruit | Seed weight (g) | Seed yield/ vine (g) | Seed yield/ plot (kg) | Seed yield/ ha (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Harvesting stages** | | | | | | | | | | |
| H1 | 59.22 | 2.05 | 8.17 | 194.56 | 134.11 | 41.88 | 13.82 | 247.75 | 2.48 | 1238.74 |
| H2 | 62.28 | 2.41 | 8.31 | 252.14 | 64.88 | 48.91 | 14.60 | 298.32 | 2.92 | 1461.59 |
| H3 | 64.52 | 2.25 | 8.55 | 311.89 | 33.32 | 49.94 | 14.43 | 311.71 | 3.12 | 1558.56 |
| Mean | 62.01 | 2.23 | 8.34 | 252.86 | 77.43 | 49.91 | 14.28 | 283.92 | 2.84 | 1419.63 |
| CD | 2.15 | 0.198 | 0.294 | 5.796 | 22.55 | 4.28 | 0.536 | 37.57 | 0.376 | 187.86 |
| **Post harvest ripening** | | | | | | | | | | |
| R1 | 62.69 | 2.31 | 8.26 | 247.22 | 95.06 | 45.41 | 14.21 | 280.24 | 2.80 | 1401.22 |
| R2 | 61.59 | 2.32 | 8.43 | 254.69 | 85.71 | 48.46 | 14.43 | 298.45 | 2.98 | 1492.26 |
| R3 | 61.48 | 2.06 | 8.34 | 256.68 | 51.52 | 46.87 | 14.21 | 273.08 | 2.73 | 1365.40 |
| Mean | 62.01 | 2..23 | 8.34 | 252.86 | 77.43 | 46.91 | 14.28 | 283.92 | 2.84 | 1419.63 |
| CD | NS | 0.198 | NS | 5.796 | 22.55 | NS | NS | NS | NS | NS |
| **Interaction** | | | | | | | | | | |
| H1 × R1 | 60.43 | 2.05 | 8.19 | 195.67 | 168.75 | 41.32 | 13.72 | 233.98 | 2.34 | 1169.89 |
| H1 × R2 | 57.97 | 1.88 | 8.07 | 191.00 | 163.20 | 42.50 | 13.71 | 275.03 | 2.75 | 1375.16 |
| H1 × R3 | 59.23 | 2.21 | 8.26 | 197.00 | 70.37 | 41.83 | 14.03 | 234.23 | 2.34 | 1171.17 |
| H2 × R1 | 63.10 | 2.44 | 8.43 | 222.00 | 74.22 | 43.57 | 14.01 | 267.99 | 2.68 | 1339.97 |
| H2 × R2 | 62.27 | 2.71 | 8.32 | 269.87 | 65.13 | 51.55 | 15.46 | 312.93 | 3.13 | 1564.67 |
| H2 × R3 | 61.47 | 2.09 | 8.19 | 264.57 | 55.27 | 51.62 | 14.32 | 296.02 | 2.96 | 1480.12 |
| H3 × R1 | 65.30 | 2.45 | 8.15 | 324.00 | 42.23 | 51.35 | 14.91 | 338.76 | 3.39 | 1693.81 |
| H3 × R2 | 64.53 | 2.39 | 8.90 | 303.20 | 28.80 | 51.33 | 14.13 | 307.39 | 3.07 | 1536.95 |
| H3 × R3 | 63.73 | 1.90 | 8.59 | 308.47 | 28.93 | 47.15 | 14.27 | 288.98 | 2.89 | 1444.92 |
| Mean | 62.01 | 2.23 | 8.34 | 252.86 | 77.43 | 46.91 | 14.28 | 283.92 | 2.84 | 1419.63 |
| CD | NS | 0.342 | NS | 10.039 | 39.06 | NS | 0.928 | NS | NS | NS |

*Effect of harvesting stages and post harvest ripening*

The interaction effect of harvesting stages and post harvest ripening was significant for fruit weight, number of filled and unfilled seeds per fruit, 100 seed weight and all seed quality parameters (Tables 1 & 2). The results are in agreement with [13].

**Table 2. Seed quality parameters as influenced by harvesting stages and post-harvest ripening in bottle gourd cv. ABG-1**

| Treatment | Germination % | Seedling length (cm) | Seedling fresh weight (mg) | Seedling dry weight (mg) | Vigour index-I | Vigour index-II | Electrical conductivity (µmhos/cm/g) |
|---|---|---|---|---|---|---|---|
| Harvesting stages | | | | | | | |
| H1 | 56.22 | 20.82 | 6688.89 | 227.33 | 1169 | 12789 | 0.484 |
| H2 | 80.11 | 25.26 | 7722.22 | 302.44 | 2028 | 24256 | 0.400 |
| H3 | 69.56 | 23.47 | 7388.89 | 272.22 | 1635 | 18989 | 0.398 |
| Mean | 68.63 | 23.18 | 7266.67 | 267.33 | 1611 | 18678 | 0.427 |
| CD | 1.23 | 1.52 | 354.83 | 14.97 | 106.63 | 1040.64 | 0.028 |
| Post-harvest ripening | | | | | | | |
| R1 | 67.67 | 23.16 | 7255.56 | 266.22 | 1587 | 18368 | 0.450 |
| R2 | 69.44 | 24.22 | 7500.00 | 266.33 | 1707 | 18993 | 0.426 |
| R3 | 68.78 | 22.17 | 7044.44 | 269.44 | 1537 | 18673 | 0.405 |
| Mean | 68.63 | 23.18 | 7266.67 | 267.3 | 1611 | 18678 | 0.427 |
| CD | 1.23 | 1.52 | 354.83 | NS | 106.63 | NS | 0.028 |
| Interaction | | | | | | | |
| H1 × R1 | 56.6 | 21.13 | 6933.33 | 204.67 | 1197 | 15224 | 0.523 |
| H1 × R2 | 55.33 | 21.70 | 6833.33 | 208.67 | 1198 | 11543 | 0.520 |
| H1 × R3 | 56.67 | 19.63 | 6300.00 | 268.67 | 1112 | 11601 | 0.409 |
| H2 × R1 | 79.33 | 26.36 | 7800.00 | 290.67 | 2092 | 23788 | 0.417 |
| H2 × R2 | 83.33 | 27.30 | 8266.67 | 317.00 | 2275 | 26406 | 0.355 |
| H2 × R3 | 77.67 | 22.10 | 7100.00 | 299.67 | 1715 | 22574. | 0.427 |
| H3 × R1 | 67.00 | 21.96 | 7033.33 | 303.33 | 1472 | 16094 | 0.410 |
| H3 × R2 | 69.67 | 23.66 | 7400.00 | 273.33 | 1649 | 19030 | 0.403 |
| H3 × R3 | 72.00 | 24.76 | 7733.33 | 240.00 | 1784 | 21844 | 0.380 |
| Mean | 68.63 | 23.18 | 7266.67 | 267.33 | 1611 | 18678 | 0.427 |
| CD | 2.13 | 2.63 | 354.83 | 25.93 | 184.69 | 1802.45 | 0.049 |

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