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Short communication

Effect of stage of harvest and post harvest ripening on hybrid seed yield and quality in bottle gourd

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ABSTRACT

The present 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. Pusa Hybrid-3 during *kharif* 2009-10 and 2010-11. The treatment consists of four stages of fruit harvest (40, 50, 60 and 70 days after anthesis), four post harvest repining periods (10, 20, 30 and 40 days post harvest ripening) and their combinations. Significantly maximum fruit weight (2.02 kg), fruit length (44.51 cm), number of filled seeds per fruit (484.3) and seed yield per fruit (72.23 g), higher germination (94.38%), seedling length (33.08 cm), protein content of seed kernel (38.43%) and oil content of seed kernel (53.74%) were recorded in the fruits harvested at 60 days after anthesis. Significantly, higher fruit weight (2.00 kg) and fruit length (45.17 cm) was noticed with 10 day of post harvest ripening period, whereas number of filled seed per fruit (472.7), was higher at 40 days of post harvest ripening period. The post harvest ripening period had significant effect on seed quality parameters, *viz*., higher germination (94.55%), seedling length (31.44 cm), weight of seed coat (0.3763 g) and weight of cotyledon (0.370) were noticed at 30 days of post harvest ripening period.

Key words: Bottle gourd, post harvest ripening, seed yield, germination.

Bottle gourd (*Lagenaria siceraria* (Molina) Standl) is an important cucurbitaceous vegetable crop grown for its fleshy fruits in tropical and subtropical regions. 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 (Biradar, 2). It 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. The contribution of seed coat to seed weight and contribution of cotyledon to seed weight and their ratio changes during physiological maturity (Ganar, 4). The stage of fruit ripening at the time of harvest determines the quality of seed. The physical indices are mainly related to fruit colour, seed and fruit weight and fruit firmness. Physiological maturity occurs when seed nutrition (protein and oil) reach their highest quantitative and qualitative levels in fruits or seeds (Berti and Johnson, 1). Thus, keeping in view of these facts explained above, the present investigation was carried out to see the effect of stage of harvest and post harvest ripening in bottle gourd.

The field experiment on hybrid seed production of bottle gourd cv. Pusa Hybrid-3 was conducted at Seed Production Unit, Division of Seed Science and Technology, IARI, New Delhi during *kharif* 2009-10 and 2010-11. The land was prepared well and furrows were opened at a distance of 300 cm apart. The recommended dose of fertilizers (100:50:50 kg/ha) were incorporated in to soil along with 20 tonnes of FYM per hectare. Two seeds per hill were dibbled at a spacing of 60 cm within row of the seed and pollen parents in separate block. The plants were thinned leaving one seedling per hill 20 days after sowing. Plant protection measures were adopted as and when required. The female flower in seed parent block and male flower in pollen parent were protected by covering with white butter paper bag before opening and pollination was carried out manually. The fruits were harvested at four different stage, *viz*., H1: 40 days after anthesis (40 DAA), H2: 50 days after anthesis (50 DAA), H3: 60 days after anthesis (60 DAA) and H4: 70 days after anthesis (70 DAA). The fruits harvested from each stage were kept for post harvest ripening for a period of 10, 20, 30 and 40 (P1, P2, P3 and P4, respectively) days later fruits were used for recording average fruit weight, average fruit length and average fruit width. The seeds were extracted manually from each stage and subjected

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to sun drying for a period of 48-72 h. After drying, average number of seed per fruit, 100-seed weight, seed yield per fruit, germination (%), seedling length (cm) and seed moisture content were recorded. The germination test and moisture content was conducted as per ISTA rules. To record the weight of seed coat and cotyledon, 50 seeds were selected randomly from the dried and cleaned seeds. The seed coat was removed from 5 seeds in ten replicates with the help of forceps and then the seed coat and remaining part (cotyledon and embryo) were weighed separately. The total protein content in the seed kernel was estimated by Lowry (1951) method using Folin's-phenol reagent and seed kernel oil was estimated by following automatic soxhlet extraction method. Pooled data were subjected to factorial RBD with three replications by employing SAS procedures using SAS version 9.2.

In the present study, stage of fruit harvest had significant influence on fruit characters, *viz.*, fruit weight (kg), fruit length (cm), fruit width (cm), number of filled seeds per fruit, number of unfilled seeds per fruit and seed yield per fruit (g) (Table 1). The fruits harvested at 60 days after anthesis recorded significantly maximum fruit weight, fruit length, number of filled seeds/fruit and seed yield/ fruit (2.02 kg, 45.57 cm, 484.30 and 72.23 g, respectively) due to complete development of fruits and seeds 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 (2) and Sureshbabu *et al*. (9) in brinjal.

Seed quality parameters, *viz*., germination (94.38%) and seedling length (33.08 cm) were significantly higher when the fruits were harvested at 60 days after anthesis. On the other hand, reciprocal values for these quality parameters were seen in fruits harvested at 40 days after anthesis. 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 (40 DAA), due to presence of large number of immature and under 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. There was a significant increase in100-seed weight from 11.35 to 15.92 g, seed coat from 0.3165 to 0.4083 g and seed cotyledon from 0.3348 to 0.3929 g with increased days after anthesis (till 60 days after anthesis). The results are in agreement with Ganar *et al*. (3) on ash gourd.

It is assumed that even after harvest of fruits, development and maturity of seeds continues, while still enclosed within the fruits, there would be transfer of food reserves to seeds from the pulp in fleshy fruit crops and ripening period of fruits after harvest may enhance the seed quality parameters. Likewise, the present study conducted on post harvest ripening period of fruits also revealed that fruit weight and fruit length (2.00 kg and 45.17 cm) was higher with ten days of post harvest ripening period and it decreased progressively with the increase in ripening period due to natural disintegration of pulp in the fruits. In all the post-harvest ripening periods, the results are also in agreement with the results of Sureshbabu *et al*. (9) in brinjal. The moisture content of seed decreased gradually with advancement of maturity period. The decrease in moisture content of seeds under post harvest ripening period of 40 days may be due to the loss of moisture from the seeds during post ripening of fruits. Similar decrease in moisture content of seeds with increase in ripening period was also observed by Krishnamurthy (5) in chilli.

Seed quality parameters, *viz*., 100-seed weight (14.36 g), germination (94.38%) and seedling length (31.44 cm) were significantly higher in the 30 days of post harvest ripening period (Table 2). The seed quality parameters enhanced significantly with increase in the post harvest fruit ripening periods up to 30 days beyond which all seed quality parameters decreased gradually with progressive increasing ripening period (40 days). 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 (Nandeesh *et al*., 7; Hamsaveni, 4). The present findings are also in corroborative with the reports of Biradar (2), and Pandita and Nagarajan (8) in chilli. In the present study, the seeds obtained from fruits of different harvests and allowed for 30 days of post harvest ripening period recorded higher protein and oil contents in seed kernel indicating the superior quality of seeds. The protein and oil contents in seed kernel were found to differ significantly among the harvest stage and post-harvest ripening period (Table 2). The protein and oil contents in seed kernel were higher at 60 DAA and 30 days of PHR. These variations can result from a combination of several factors, *viz*., physical soundness of seeds and maturity of seed. Similar results were also reported by Loukou (6) in bottle gourd.

The significant interaction effect between stage of harvest and post harvest ripening period (H × P) was

Table 2. Seed quality parameters as influenced by stage of harvest and post-harvest ripening in bottle gourd cv. Pusa Hybrid-3 (pooled data 2009-10 and 2010-11).

Treatment	Germination (%)	Seedling length (cm)	Seed moisture (%)	Seed coat weight (g)	Weight of seed cotyledon (g)	Protein content (%)	Oil content (%)
Stage of harvest							
H1	71.90	27.93	9.88	0.3165	0.3348	27.76	46.20
H2	90.90	30.05	9.37	0.3422	0.3518	34.24	51.06
H3	94.38	33.08	9.11	0.4083	0.3929	38.43	53.74
H4	91.61	22.94	8.97	0.3585	0.3397	34.74	51.18
Mean	87.20	28.50	9.33	0.3564	0.3548	33.79	50.54
$CD_{0.05}$	0.263	1.826	0.021	0.003	0.0014	0.175	0.192
Post-harvest ripening							
R1	73.41	27.73	9.65	0.3326	0.3363	31.08	49.71
R2	88.82	29.97	9.44	0.353	0.3383	33.35	50.04
R3	94.55	31.44	9.18	0.3763	0.3770	36.16	51.55
R4	92.01	30.93	9.05	0.3637	0.3676	34.57	50.88
Mean	87.20	28.50	9.33	0.3564	0.3548	33.79	50.54
$CD_{0.05}$	0.263	1.826	0.021	0.003	0.0014	0.175	0.192
H1 × R1	17.73	20.64	10.47	0.2629	0.2879	24.77	45.01
H1 × R2	81.51	29.72	10.20	0.3398	0.3002	26.51	45.79
H1 × R3	96.00	31.06	9.62	0.3535	0.3694	32.62	47.18
H1 × R4	92.36	30.28	9.23	0.3742	0.3816	27.13	46.80
H2 × R1	81.38	25.40	9.59	0.3114	0.3517	28.73	49.87
H2 × R2	86.01	27.48	9.49	0.3488	0.3615	34.44	50.30
H2 × R3	98.08	34.56	9.24	0.3935	0.3513	38.20	52.46
H2 × R4	98.13	32.75	9.14	0.3581	0.3426	35.57	51.61
H3 × R1	97.35	33.66	9.25	0.339	0.3648	36.98	53.37
H3 × R2	94.69	32.15	9.20	0.3507	0.3563	37.75	53.38
H3 × R3	93.11	33.01	9.03	0.4403	0.4298	38.97	54.54
H3 × R4	92.36	33.50	8.97	0.3751	0.4208	40.00	53.68
H4 × R1	97.16	31.21	9.30	0.3526	0.3409	33.85	50.59
H4 × R2	93.08	30.53	8.88	0.3296	0.3352	34.69	50.68
H4 × R3	91.00	28.86	8.82	0.446	0.3575	34.85	52.01
H4 × R4	85.20	27.17	8.86	0.3264	0.3252	35.57	51.44
Mean	87.20	30.12	9.33	0.3564	0.3548	33.79	50.54
$CD_{0.05}$	0.527	3.652	0.042	0.007	0.0029	0.350	0.385

noticed on fruit weight, fruit length and fruit width. The significantly highest fruit weight (2.29 kg), fruit length (46.83 cm) and fruit width (9.29 cm) was recorded with H3P1, H3P2 and H2P1, respectively. This may be due to greater accumulation of food reserve in seeds of fruits harvested at later stage and early days of post harvest ripening period. There was significantly maximum seed moisture content (10.47%) and minimum (8.86%) was recorded in H1P1 and H4P4, respectively. The decrease in moisture content of seeds with advancement of ripening period may be due to more loss of moisture from the seed during fruit ripening period. Similar decrease in moisture content of seeds with increase in ripening period was also observed by Krishnamurthy (5) and Biradar (2) in chilli. The seed quality parameters, *viz*., germination

Table 1. Fruit and seed yield parameters as influenced by stage of harvest and post-harvest ripening in bottle gourd cv. Pusa Hybrid-3 (pooled data 2009-10 and 2010-11).

Treatment	Fruit wt. (kg)	Fruit length (cm)	Fruit width (cm)	Filled seeds/fruit	Unfilled seeds/fruit	100-seed weight (g)	Seed yield/ fruit (g)
Stage of harvest							
H1	1.23	43.49	8.60	363.63	204.91	11.35	48.96
H2	1.57	43.68	9.05	423.86	60.31	14.84	51.77
H3	2.02	44.51	8.54	484.30	29.30	15.92	72.23
H4	1.81	40.00	7.85	386.09	18.09	13.45	61.37
Mean	1.66	42.92	8.51	414.47	78.15	13.89	58.58
$CD_{0.05}$	0.026	0.460	0.177	3.328	2.379	0.087	2.017
Post-harvest ripening							
R1	2.00	45.17	8.56	355.63	96.84	13.35	49.51
R2	1.77	44.25	8.55	410.40	80.06	13.95	56.37
R3	1.60	42.15	8.47	419.14	73.18	14.36	67.63
R4	1.27	40.35	8.47	472.70	62.53	13.89	60.81
Mean	1.66	42.92	8.51	414.47	78.15	13.89	58.58
$CD_{0.05}$	0.026	0.460	NS	3.328	2.379	0.087	2.017
H1 × R1	1.51	45.07	8.39	309.25	263.65	10.06	42.19
H1 × R2	1.21	44.49	8.40	381.08	213.98	11.06	52.64
H1 × R3	1.27	41.92	8.65	378.18	179.75	12.32	50.46
H1 × R4	0.94	42.49	8.94	386.02	162.26	11.96	50.55
H2 × R1	2.01	46.22	9.29	418.18	69.51	14.34	52.36
H2 × R2	1.68	44.48	9.15	457.27	59.13	15.62	37.64
H2 × R3	1.40	43.36	8.85	372.00	61.01	15.33	51.96
H2 × R4	1.19	40.66	8.92	447.97	51.60	14.07	65.12
H3 × R1	2.29	44.31	8.64	413.46	29.80	15.06	58.59
H3 × R2	2.08	46.83	8.64	396.28	29.26	16.11	74.77
H3 × R3	2.06	44.76	8.50	524.72	36.30	16.52	94.69
H3 × R4	1.64	42.17	8.39	602.72	21.84	15.97	60.85
H4 × R1	2.17	41.95	7.90	281.64	24.39	13.93	44.9
H4 × R2	2.09	43.37	8.01	406.98	17.88	13.02	60.43
H4 × R3	1.68	38.57	7.87	401.64	15.67	13.28	73.42
H4 × R4	1.31	36.11	7.62	454.09	14.43	13.55	66.73
Mean	1.66	42.92	8.51	414.47	78.15	13.89	58.58
CD (P = 0.05)	0.053	0.921	0.354	6.657	4.759	0.174	4.035

(98.13%) and seedling length (34.56 cm) were higher when fruits were harvested at 50 days after anthesis and kept for 30 days post harvest ripening period (H2P3). These results are similar to the findings of Nandeesh *et al*. (7) in cucumber. The stage of harvest and post-harvest ripening was found to be significantly higher protein and oil contents of seed kernel (40.00 and 54.54%, respectively) were recorded in the fruits harvested at 60 days after anthesis and 40 and 30 days of post-harvest ripening period respectively (Table 2).

It is concluded that bottle gourd fruits should be harvested at 60 days after anthesis and fruits should be allowed to 30 days post-harvest ripening for higher seed yield and enhancing quality of hybrid seed.

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