Effect of time of harvest, stage of fruit ripening, and post-harvest ripening on seed yield and germinability of local garden egg (*Solanum gilo* Radii)

E. T. BLAY, E. Y. DANQUAH & A. ABABU
Department of Crop Science, University of Ghana, Legon, Ghana

SUMMARY

Two cultivars of garden egg (*Solanum gilo*), Legon 1 and Nyaduahene, were used in the study. The first harvest was done 4 weeks after 50 per cent fruit set, followed by a second harvest, 4 weeks later. Seeds from three fruit maturity stages, mature white, yellow ripe and red ripe, were investigated. Seeds were extracted from half of the fruits harvested from each stage immediately after harvest while the other halves were stored at room temperature to ripen to the soft-red stage before seed extraction. Fruit weight in both cultivars decreased with plant age. Fruits harvested at the yellow-ripe stage produced the highest number of seeds per fruit. Fruits harvested at the mature white stage had the lowest seed yield. Seed yield was higher in the second harvest than in the first. Cultivar differences were observed in 1000-seed weight, but seed weight in both cultivars increased with fruit maturity. Post-harvest ripening to the soft-red stage increased the number of seeds extracted in fruits harvested at the mature-white stage as well as the 1000-seed weight in fruits harvested at the mature-white or yellow stages. Post-harvest ripening also improved the total percentage germination of seeds extracted from fruits harvested at the white or yellow stages, but decreased the percentage germination in seeds from fruits harvested at the red-ripe stage.

Original scientific paper. Received 14 Oct 98; revised 3 Sep 99.

RÉSUMÉ

BLAY, E. T., DANQUAH, E. Y. & ABABU, A.: *Effet du temps de la récolte, le stade de mûrissement de fruit et le mûrissement de past-récolte sur le rendement de graine et la capacité germinative de l'aubergine locale* (Solanum gilo *Radii*). Deux variétés d'aubergine (*Solanum gilo*), Legon 1 et Nyaduahene (Chef d'aubergine), étaient cultivées pour l'étude. La première récolte était faite 4 semaines après 50 pour cent de porte-fruit suivie par une deuxième récolte, 4 semaines plus tard. Les graines de trois stades de la maturité de fruit, mûr blanc, mûrissage jaune et mûrissage rouge, étaient enquêtés. Des graines étaient extraites de la demi des fruits récoltées à chaque stade aussitôt après la récolte alors que les demies qui restent étaient mises en réserve à une température ambiante de mûrir au stade de mûrissage rouge avant d'extraire la graine. Le poids de fruit des deux variétés diminuait avec l'âge de la plante. Les fruits récoltées au stade de mûrissage jaune rendait la plus grande quantité de graines par fruit. La plus petite quantité de graine rendue était obtenue des fruits récoltées au stade de mûr blanc. Le rendement de graine était plus élevé dans la deuxième récolte que dans la première. Des différences entre les variétés étaient observées en poids de 1000 graines mais le poids de graine des deux variétés augmentait avec la maturité de fruit. Le mûrissement de post-récolte au stade de mûrissage rouge aboutissait à une augmentation de quantité de graines extraites des fruits récoltées au stade de mûr blanc ainsi qu'une augmentation du poids de 1000 graines de fruits récoltées au stade de mûr blanc ou de mûrissage jaune. Le mûrissement de post-récolte améliorait également le pourcentage total de la germination de graines extraites de fruits récoltées au stade de mûr blanc ou de mûrissage jaune mais diminuait le pourcentage de germination des graines de fruits recoltées au stade de mûrissage rouge.

Introduction

Garden egg (*Solanum gilo*) is one of the most important members of the genus *Solanum* cultivated in West Africa. Most Ghanaians prefer its fruits to those of aubergines because, unlike the latter, the fruits are less liable to blacken on peeling, cutting or boiling. The fruits are eaten raw as snack, or used in the preparation of soup and stew while the leaves are savoured as pot herbs in some communities. The plant is a much branched, perennial shrub with small egg-shaped or globular fruits, about 5 to 6.5 cm in diameter. It is normally cultivated as an annual crop (Tindall, 1976), but the duration of fruiting in most cultivars extends into 2 years under optimum growing conditions, making it possible to harvest the crop several times during the fruiting period (Rice, Rice & Tindall, 1987). Fruits for table are harvested at the immature or mature, unripe stage but usually before full-seed maturation. For seed production, fruits are harvested when ripe and the seeds extracted without prior after-ripening. Many small, white to cream-coloured seeds may be obtained from each fruit. According to FAO (1961), for seed production, the fruits are allowed to mature beyond the edible stage before harvesting.

Sedigama *et al.* (1991) reported that the age of the mother plant during flower initiation or seed maturation also had considerable influence on seed germinability. However, seed germinability in several crops has been reported to be heavily dependent on fruit maturity at seed extraction. For instance, in a pepper (*Capsicum annuum*) variety, California Wonder, seeds extracted at marketable maturity (40 days after anthesis) germinated completely when colour development had started (Sayed & Mohammoud, 1952). A 3-year study of seed production in aubergine (*Solanum melongena*) by Quagliott & Cavachini (1968) showed that a minimum of 50 days from anthesis to harvesting was required to produce good-quality seed. The rate of germination increased until 90 days after anthesis. According to Konogini (1980), garden egg seeds extracted from fruits at the red-ripe stage had the highest percentage germination (83 per cent), followed by those harvested at the yellow (12.5 per cent) and white (0.0 per cent) stages in that order. Jayabarathi *et al.* (1990) reported that in the aubergines, fruit and seed yields were highest when fruits were harvested at the completely yellow-ripe stage. Also, seed germination and values for vigour indices were highest in seeds harvested at this stage. Seeds extracted from mature fruits of Butternut squash (*Cucurbita moschata*) had a higher percentage of germination than those from immature fruits.

Studies conducted by Ellis *et al.* (1993) also indicated that in tomato (*Lycopersicon esculentum*) and peppers (*Capsicum* spp.) as well as cereals, seed quality was maximum after the seed-filing stage. In cereals, seed quality subsequently declined. However, further seed maturation did not produce any significant effects in tomato or pepper seeds. In bitter gourd (*Momordica charantia*), Krishnasamy (1991) observed that seeds continued to mature in fruits which were harvested before ripening and stored under ambient conditions. Harvesting 3 days before extracting seed enabled field losses to be avoided and high-quality seeds to be obtained. Most garden egg farmers in Ghana obtained their seed by extracting from part of their harvest.

Methods of seed production are highly variable. While some farmers extract seed from the first fruits, others wait until the middle of the harvesting period to extract seed; others still extract seeds only towards the end of crop duration when ripe fruits abound in the field for which there is no market. The stage of fruit ripening at seed extraction is, therefore, also quite varied. The recent increase in acreage under cultivation and the development of the export market for the crop call for the adoption of efficient strategies for producing high yields of good-quality seed.

This study aimed at determining the following:

1. Effect of time of harvest (period within the harvest duration when fruits are harvested for seed extraction) on seed yield and germinability.

2. Influence of stage of fruit ripening at harvest, and after ripening on seed yield and germination percentage.
3. Varietal response to harvesting strategies for optimum seed yield and quality.

Materials and methods

Two experiments, a field experiment on seed production and a laboratory evaluation of germinability of seeds extracted from the two cultivars at the various periods and stages between July 1997 and March 1998, were conducted.

Experiment 1 (field experiment)

The field experiment was conducted for 5 months in the Sinna's garden at the University of Ghana, Legon. Seeds of two cultivars of *Solanum gilo,* Legon 1- L1 and Nyaduahene-NH, were nursed, sown in seed boxes in July 1997, and pricked out onto a nursery bed 6 days after emergence. At 6 weeks after pricking out, the seedlings were transplanted onto a piece of land. The experimental design was a randomized complete block with four replications. Each replication comprised two plots. Plot 6 was 2.4 m × 4.0 m. There were four rows per treatment. Each row had six plants. Spacing between plants was 80 cm × 80 cm. The cultural practices followed during the growing period included the aplication of 20 g NPK (15-15-15) per plant 10 days after transplanting (312 kg/ha) followed by top dressing with 10 g sulphate of ammonia per plant (312 kg/ha) after 2 weeks. Watering and weeding were carried out as and when necessary. Insect pests were controlled with a 2-weekly application of 2 ml/l of Karate starting from 2 weeks after transplanting. At 50 per cent flowering, flowers with treatment were tagged and used to collect data on fruits and seeds.

Harvesting was started 4 weeks after 50 per cent fruit set and was carried out at monthly intervals. Fruits at three different stages of ripening, *viz* mature white (21 days from flowering to fruit maturity), yellow (7 days after maturity), and red ripe (3 days after yellowing), were harvested during each harvesting. Table 1 shows the weights of the different categories of fruits at harvesting for seed extraction. Twenty fruits of each fruit-maturity class were rinsed with tap water and surface-dried and divided into two groups of 10 each. For each fruit-maturity class, seeds were extracted from one group directly while the other group was kept at room temperature (28±2 °C) and allowed to ripen through the various stages of ripening to soft-red (Table 2). The procedure was repeated for each harvest.

TABLE 1

Mean Fruit Weight

Treatment	*Mean fruit weight (g)*
LI HI (Legon 1 Harvest 1)	72.69
LI H2 (Legon 1 Harvest 2)	53.99
NH HI (Nyaduahene Harvest 1)	64.28
NH H2 (Nyaduahene Harvest 2)	44.09
LSD 5 %	11.48

TABLE 2

Stages of Ripening to Soft Red for Fruit-Maturity Classes

Maturity class	*Stages of ripening to soft red*
Mature white	Mature white -- yellow--red--soft red
Yellow ripe	Yellow ripe--red--soft red
Red	Red--soft

The data collected were days to onset of flowering, days to 50 per cent flowering, days to 50 per cent fruit set, number per node, number of fruit per plant and mean fruit weight, and days from anthesis to each fruit-maturity class. The number of seeds/fruit, seed weight/fruit, and 1000-seed weight of seeds extracted from each fruit-maturity class were also recorded for each harvest.

Experiment 2 (germination tests)

Twenty-five seeds from each fruit-maturity class with or without post-harvest ripening were cultured in sterilized Petri plates lined with three sterilized filter paper and moistened with distilled water. There were six treatments per variety as follows:

1. Seeds extracted from mature white fruits without after-ripening.
2. Seeds extracted from yellow ripe fruits without after-ripening.
3. Seeds extracted from red ripe fruits without after-ripening.
4. Seeds from mature white fruits which had been after-ripened to soft red.
5. Seeds from yellow ripe fruits which had been after-ripened to soft red.
6. Seeds from red ripe fruits which had been after-ripened to soft red.

The Petri plates containing the seeds were arranged in a completely randomized design in an incubator at 28 ± 2 °C. There were four replications per treatment. The filter papers lining the Petri plates were moistened by adding a few drops of distilled water as required. These seeds were examined daily for sign of germination. A seedling was regarded as germinated when the radicle had emerged completely and the two cotyledons were fully expanded. Germinated seedlings were recorded daily and discarded. The experiment covered a period of 2 weeks and was repeated for each batch of seeds from each harvest. Data were collected on days to onset of germination, germination rate, daily germination counts, and percentage germination.

The data were subjected to analysis of variance and where the differences between treatment means were significant, the LSD test was used to separate the means.

Results and discussion

The two varieties did not differ significantly in days to anthesis or 50 per cent flowering. Legon 1 (L1) flowered within 34-51 days after transplanting while Nyaduahene (NH) flowered between 36 and 57 days after transplanting with a mean of 45.1 and 44.4 days, respectively. The Legon variety reached 50 per cent flowering in 45 days after transplanting and was a day earlier than Nyaduahene. Both varieties produced one fruit per node and averaged four fruits per plant at the end of the second harvest. The fruit yields were considerably lower than what has been reported by Tweneboa-Koduah (1981). The environmental conditions during the experimental period were particularly harsh with very low rainfall (271.8 mm for the 9-month period) and high temperatures (maximum 31.1-33.5 °C). This could account for the low yields in the first and second harvests.

The mean fruit weight of L1 was slightly higher but not significantly different from that of NH for the respective harvests. Within varieties, however, there was a significant decline in fruit weights from Harvest 1 to Harvest 2 (Table 2). Fruits at the yellow-ripe stage produced the highest number of seeds per fruit (Table 3). Fruits harvested at the white stage also produced fewer seeds than red-ripe fruits. This confirms the observation by Jayabarathi *et al.* (1990) that the fruit and seed yield of bringal (*Solanum melongena*) were highest when fruits were harvested at the yellow ripe stage.

In Harvest 1, Nyaduahene produced mean number of seeds per fruit of 566 ± 54.20 with a coefficient of variation of 23.5 per cent compared to 530 ± 19.46 and a coefficient of variation of 6 per cent in Legon. With the exception of fruits harvested from L 1 during the first harvest, seed numbers for white fruits increased considerably when they were allowed to ripen completely in storage. This corroborates the finding of Krishnasamy (1991) that seeds of bittergourd (*Momordica charantia*) harvested before ripening and stored under ambient conditions continued to mature in the fruits. The results also confirm the finding of FAO (1991) that in egg plants, seeds in fruits that had not attained edible maturity continued to mature if they were not extracted immediately after harvest but stored for some days.

Seed weight per fruit

Seed weight per fruit increased with maturity

TABLE 3

Mean Number of Seeds/Fruit

Treatment	Harvest 1				Harvest 2			
	Legon 1		Nyaduahene		Legon 1		Nyaduahene	
	Mean	SE (+/-)	Mean	SE (+/-)	Mean	SE (+/-)	Mean	SE (+/-)
White	518	175.77	455	55	479	54.65	555	24.45
Yellow	553	89.02		37.25	679	125.25	629	43.97
Red	565	108.00	622	127.50	527	63.48	489	33.54
White-soft red	444	76.75	535	85.23	566	36.47	628	47.08
Yellow- soft red	523	98.09	624	70.60	505	58.09	524	54.07
Red-soft red	575	106.07	394	58.24	527	46.07	455	28.98
Red-soft red	530	19.46	566	54.20	547	28.96	549	28.96
CV (%)	6		23.5		12.9		12.9	

(Table 4). Also, after ripening resulted in increase in seed weight per fruit, indicating continued development and progressive increase in dry matter accumulation in seed during fruit maturity and after harvesting. The seed weight per fruit was higher in NH (1.22-1.37 g) than in L1 (1.03-1.06 g) which had relatively larger fruits, suggesting that seed weight per fruit may be more of a function of genotype than fruit size. The seed weight/fruit of NH in the red to soft-red treatment decreased conspicuously. This was probably due to post-harvest losses caused by seed rot and insect pest damage observed during the after-ripening treatment. This poses a real set back in the adoption of after-ripening treatment, especially for fruits which have been retained on the plant for a longer time and, therefore, exposed to fruit borer infestation. The 1000-seed weight (Table 5) also followed a similar trend to seed weight per fruit and increased with physiological maturity of the fruits. This suggests that dry matter accumulation in the seeds continued as the fruit matured. Nyaduahene again had a higher mean 1000-seed weight (2.17 ± 0.38 to 2.7 ± 0.22 g) than Legon 1, which had a value of 1.8±0.31g for each of the harvests. Even though the 1000-seed weight in L1 remained the same in both harvests, in NH, the seed weight increased in the second harvest. Increase in seed weight per fruit from the first to the second harvest was observed only in NH.

TABLE 4

Mean Seed Weight/Fruit (g)

Treatment	Harvest 1		Harvest 2	
	Legon 1	Nyaduahene	Legon 1	Nyaduahene
White	0.58	0.86	0.60	0.99
Yellow	1.00	1.11	0.77	1.57
Red	1.25	1.49	1.16	1.49
White-soft red	0.71	1.09	0.91	1.00
Yellow-soft red	1.26	1.50	1.21	1.73
Red-soft red	1.38	1.26	1.70	1.00
Mean	1.03 ± 0.13	1.22 ± 0.10	1.06 ± 0.16	1.37 ± 0.13
CV(%)	31.6	20.6	36.8	22.5

Effect of stage of fruit maturity and post-harvest ripening on seed germination

Fig.1 shows that LIWSR had the highest germination at 5 days followed by LIRSR, LIY and L1W in that order. L1RSR started as the second highest and increased rapidly until the day it had the highest germination which was sustained till the end of the experiment. L1Y started slowly and maintained this position throughout. On the contrary, L1R started slowly with less than 1 per

TABLE 5

Mean 1000-Seed Weight (g)

Treatment	*Harvest 1*		*Harvest 2*	
	Legon 1	*Nyaduahene*	*Legon 1*	*Nyaduahene*
White	0.5	1.0	0.5	2.0
Yellow	2.0	1.5	1.5	3.0
Red	2.5	3.0	2.5	3.0
White-soft red	1.5	1.5	2.0	2.0
Yellow-soft red	2.5	3.0	2.0	3.2
Red-soft red	2.0	3.0	2.5	3.0
Mean	1.83 ± 0.31	2.17 ± 0.1310	1.06 ± 0.16	2.7 ± 0.22
CV(%)	41	42	41	20

cent germination up to 8 days after sowing, but incréased rapidly thereafter until the 15th day when it reached the same level of germination as the highest (L1RSR). LIR started slowly but had higher daily counts from the 9th day. The seeds extracted from mature white fruits without post-harvest ripening recorded zero germination, possibly a result of dormancy. This finding corroborates the report by Konogini (1980) regarding zero germination in garden egg seeds extracted from mature white fruits without after ripening.

In post-harvest ripened fruits, germination rate was fastest in LIWSR, followed by LIRSR and LIYSR in that order. In NH seeds (Fig. 1) extracted from fruits without prior post-harvest ripening, germination started on the 7th day (DAP) with seeds from red fruits. This was followed by NHY on the 8th day. Again, the seeds from mature white fruits without post-harvest ripening (NHW) failed to germinate. Germination in seeds extracted after post-harvest ripening started on the 6th day for all the three stages of maturity. When all the six treatments are considered, seed from NHR had the highest daily counts followed by NHYSR, and NHWSR. The counts were lowest in NHY while NHW had no germination.

In the second harvest within

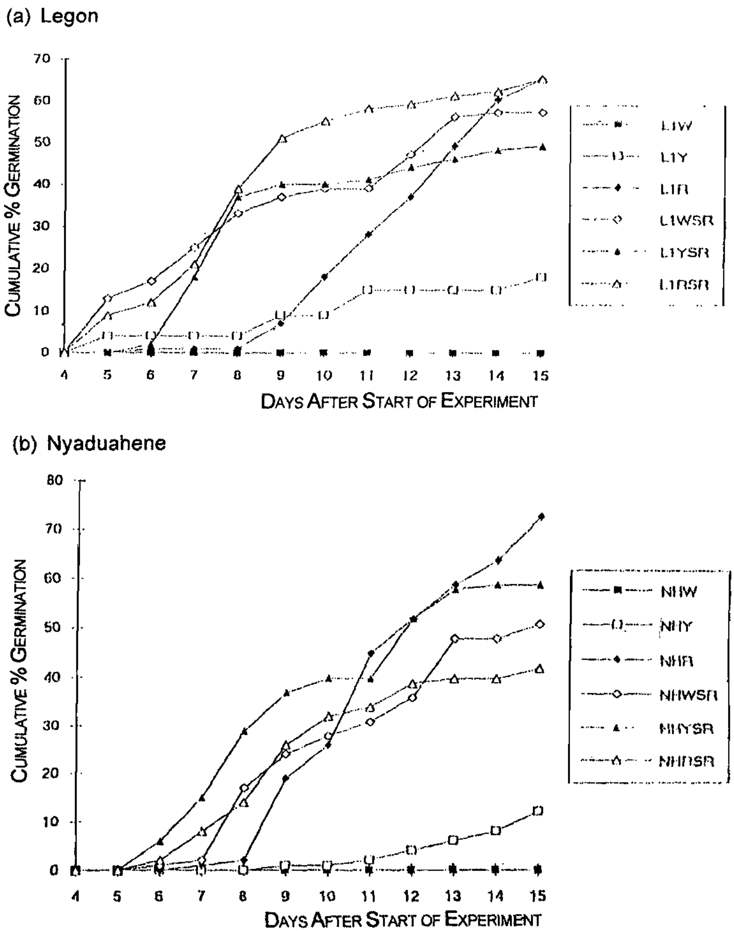

Fig. 1. Effect of different stages of fruit maturity and post-harvest ripening on germination of garden egg seeds for (a) Legon 1 and (b) Nyaduahene for Harvest 1.

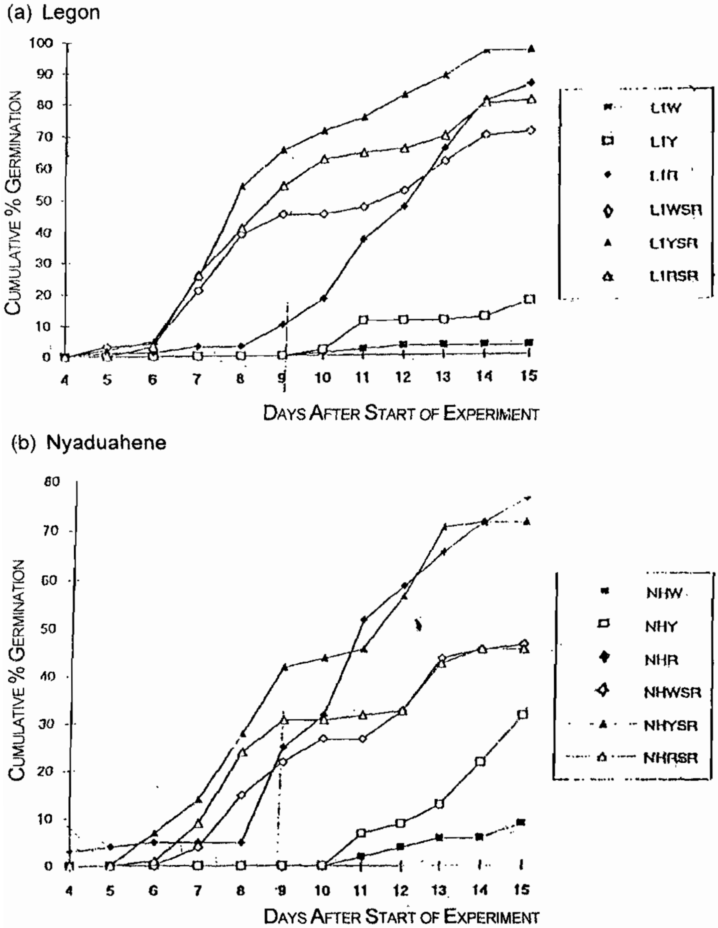

Fig. 2. Effect of different stages of fruit maturity and post-harvest ripening on germination of garden egg seeds for (a) Legon 1 and (b) Nyaduahene for Harvest 2.

the L1 treatments (Fig. 2a), LIR, LIWSR and LIYSR started germination on the 5th day, LIRSE on the 6th day, while the seeds from LIY and LIW did not commence germination until the 10th DAP. The germination rate was highest in LIYSE and lowest in LIW (Fig. 2a). For NH, seeds from mature red fruits without post-harvest ripening (NHR) were the first to germinate (4 DAP), the NHWSR started on the 7th day while the NHW and NHY germinated much later (11 DAP) (Fig. 2b). The treatments NHR and NHYSE recorded the highest daily percent germination, with the lowest germination percentage in NHW. In all treatments, post-harvest ripening improved the onset and rate of germination.

Table 6 shows that germination was poor in seeds extracted directly from white or yellow fruits of both cultivars in the first harvest. Both the LIW and NHW seeds had zero germination while the seeds from the yellow ripe fruits LIY and NHY had 18 and 12 per cent germination, respectively. Seeds extracted directly from the red fruits without post-harvest ripening (LIR and NHR) showed relatively high percentage germination of 75 for LIR and 73 for NHR. This finding supports what Yur'eva & Polumorpuinova (1994) observed in tomatoes, in which seeds from fruits had low germination, but germination increased from 12 to 88 per cent on ripening. A similar observation was also made by Sayed & Mahammoud (1952) in *Capsicum annuum*.

After ripening drastically improved percentage germination in seeds extracted from fruits harvested at the white or yellow stages. From L1, L1WSR had germination percentage of 57 while NHWSR from NH had 49 per cent. Post-harvest ripening of red fruits to soft red, however, resulted in decreased percentage germination (65 per cent) compared to 75 per cent in the seeds from red fruits. The results were similar for fruits harvested from NH (Table 6). In the second harvest, seeds from fruits harvested at the mature white and yellow stages had lower percentage germination than those from

TABLE 6

Effect of Stage of Fruit Maturity and Post-harvest Ripening on Days to Germination and Percentage Germination of Garden Egg (Legon 1 and Nyaduahene)

Cultivar treatment	*Harvest 1* *Mean days to germination*	*% germination*	*Harvest 2* *Mean days to germination*	*% germination*
LIW	0	0	5.3 ± 2.68	3 ± 1.91
LIY	3.8 ± 2.5	18 ± 9.3	10.8 ± 0.68	67 ± 4.12
LIR	8.5 ± 0.87	75 ± 5.51	8.3 ± 1.11	84 ± 6.73
LIWSR	5.0 ± 0	57 ± 3.79	6.3 ± 0.48	70 ± 6.0
LIYSR	6.5 ± 0.29	49 ± 4.12	5.8 ± 0.48	96 ± 4.62
LIRSR	5.5 ± 0.29	65 ± 9.43	6.5 ± 0.29	80 ± 10.07
NHW	0	0	8.5 ± 2.84	9 ± 3.0
NHY	11.8 ± 1.25	12 ± 3.22	11 ± 0	32 ± 4.16
NHR	8.3 ± 0.48	73 ± 1.0	5.3 ± 1.25	87 ± 5.74
NHWSR	7.8 ± 0.63	51 ± 14.55	7.5 ± 0.29	47 ± 3.0
NHYSR	6.5 ± 0.29	59 ± 11.12	6.5 ± 0.5	72 ± 7.48
NHRSR	7.0 ± 0.41	42 ± 10.52	7.0 ± 0.14	46 ± 7.19
LSD (P = 0.05)	0.17	5.81	0.36	15.21

red fruits, and germination improved with post-harvest ripening for the seeds from white and yellow fruits, but not for the fruits harvested at the red ripe stage.

Even though in both cultivars seeds extracted directly from mature fruits failed to germinate, similar seeds extracted during the second harvest showed some germination, albeit slow (Fig. 2a and b) and low. Therefore, the time of harvest, which is a reflection of the age of the mother plant at harvesting of fruits for seed extraction, may seemingly influence the quality of seeds. Generally, germination percentages improved in seeds from Harvest 2 compared to Harvest 1. This is in tune with the higher mean seed yield and mean seed weight observed in the second harvest as against the first (Tables 3 and 4). This could be attributed to better dry matter accumulation, which provided more food reserve in the seed, which in turn improved germination. Mean seed weight in L1, however, did not show any change from the first harvest to the second. The indicators are that seed yield and seed quality are better in fruits obtained later during the harvesting period than in the first fruits. The best stages for handling fruits for seed extraction are the yellow after ripened to soft red or red ripe fruits, which are extracted directly without prior after ripening. In the absence of ripe fruits, edible white maturity fruits will produce some viable seeds at edible maturity when they are stored at ambient temperatures to ripen to the soft red stage. The performance of plants raised from seeds extracted from fruits at the various maturity stages are being studied.

Conclusion

From the results of the study, it appears that post-harvest ripening to the soft-red stage before seed extraction enhances seed yield and quality. In fruits harvested at the red-ripe stage, post-harvest ripening to soft red led to seed losses caused by seed germination, rot or insect damage. While seed yield quality in mature white fruits is low, post-harvest ripening produced some viable seeds. This could be exploited for collection of germplasm where ripe fruits are unavailable. For large-scale seed production, fruits may be harvested at the yellow-ripe stage and after ripened before the seed is extracted. This strategy will stimulate higher fruit and seed yield per plant and also prolong the life of the crop.

REFERENCES

Ellis, R. H., Demir, I., Pieta-Eilho, C., Come, D. & Corbineau, F. (1993) *Proceedings of the Fourth International Workshop Seed: Basic and Applied Aspects of Seed Biology,* 20-24th July 1992. **3**, 897-904.

FAO (1961) *Agricultural and horticultural seeds: Their production, control and distribution.* FAO Plant Production Series, Rome, FAO.

Jayabarathi, M., Palanisamy, V., Kalayathi, D. & Balamurugan, P. (1990) Influence of harvesting conditions on the yield and quality of bringal seeds. *Veg. Sci.* **17**(2), 113-118.

Konogini, J. Y. (1980) *Effect of Chlorox and age at seed extraction on germination of garden egg* (BSc Agric. Dissertation). University of Ghana, Legon.

Krishnasamy, V. (1991) Post-harvest seed maturation in bittergourd. *J. appl. Seed Prod.* **9**, 41-43.

Quagliott, L. & Cavachini, P. (1968) Morphological and physiological characteristics of egg plant seeds obtained from fruits harvested at different stages of ripeness. *Ann. Fac. Sci Agrar. Torino* **4**, 235-246.

Sayed, S. M. & Mahammoud, E. L. (1952) Viability of seeds harvested at different stages of maturity. *Proc. Am. hort. Sci.* **60**, 327-332.

Sedigama, M. A. N., Asali, E. W. D., Silva, E. M. A. Cardoso, A. A. & Silva Da, R. F. (1991) The influence of the time of harvesting and ripening stage on seed germination of the Peruvian carrot (*Arcadia xantherrhiza*). *Revista bras. Sementes (Brazil)* **13**(1), 69-71.

Rice, P. P., Rice, L. W. & Tindall, H. D. (1987) *Fruit and vegetables in Africa.* London, MacMillan Publishers Ltd.

Tindall, H. D. (1976) *Fruit and vegetables in West Africa.* FAO Plant Production and Protection Series. Rome, FAO.

Tweneboah-Koduah (1981) *The performance of three promising varieties of local garden egg* (Solanum gilo) *on the Accra Plains* (B Sc Agric. Dissertation). University of Ghana, Legon.

Yur'eva, L. & Polumorpuinova, K. A. (1974) Effect of stage of fruit maturity on germination in tomatoes. *Proc. Am. hort. Sci.* **92**, 459-463.