Emirates Journal of Food and Agriculture. 2022. 34(2): 144-150
doi: 10.9755/ejfa.2022.v34.i2.2818
http://www.ejfa.me/

RESEARCH ARTICLE

The effect of ripeness phases on seed and fruit quality of eggplant (*Solanum melongena* L.)

Vukašin Popović[1,*], Slavoljub Lekić[2], Biljana Kiprovski[1], Adam Takač[1]

[1]Institute of Field and Vegetable Crops, Maksima Gorkog 30, Novi Sad, Serbia. [2]Department of Crop Science, Faculty of Agriculture, University of Belgrade, Nemanjina 6, Belgrade, Serbia.

ABSTRACT

A three-year experiment was conducted to determine the influence of ripening, variety and the production year (2017-2019) on seed and fruit quality of eggplant. The 1000 seed weight, germination capacity, the total protein and oil content of seeds as well as the total protein and sugar content of fruits were determined in three ripeness phases across three production years. All examined varieties exhibited significant differences in the weight of 1000 seeds during ripening, which varied from 1.44 to 4.42 g. Seeds extracted from fruits that reached commercial ripeness did not germinate. As the fruit ripens, its total sugar and protein content decreases, while the reverse is detected in the case of total protein and oil content of seeds. The full ripeness phase was the optimal time for harvesting fruits to obtain high germinating seeds.

Keywords: biochemical parameters; eggplant; ripeness; seed germination; the weight of 1000 seeds

INTRODUCTION

There are two opinions about the geographical origin of eggplant (*Solanum melongena* L.). The first one is that the plant is native to India and Indochina (Bhaduri, 1951; Vavilov, 1951; Li, 1969; Zeven and Zhukovsky, 1975; Lester and Hasan, 1991). The other is that eggplant originated from Southwest Asia, Arabia, Japan and China (Khan, 1979). Some authors claim in their studies that *Solanum melongena* originated from the African species *Solanum incanum* (Karihaloo and Gottileb, 1995).

Eggplant is produced worldwide on 1,847,787 ha with the average yield of about 30 tones per hectar. Leading countries in areas harvested are: China (781,695 ha), India (727,000 ha), Egypt (43,818 ha), Indonesia (43,954 ha), Turkey (23,337 ha) and others (FAO, 2019). Having been introduced from Turkey to Serbia over 100 years ago, eggplant has been grown mostly in gardens, while the production in the open field has been increasing in recent years.

Fruits of *Solanaceae* family show great morphological diversity including size, shape and color, both within and between different species (Wang et al., 2015). Fully ripe fruits take on dark brown, yellow-brown or dark yellow color. The chemical composition of the fruit is significantly influenced by season, cultivation environment (San José et al., 2014), ripening (Esteban et al., 1992; Mennella et al., 2012; Zaro et al., 2014) and genotype (Raigon et al., 2008; Kaur et al., 2014; Niño-Medina et al., 2014; Quamruzzaman et al., 2020; Martínez-Ispizua et al., 2021).

When conditions for production are optimal, it takes 7 to 10 days for the eggplant plant to sprout. The length of the vegetation period necessary for reaching commercial ripeness is from 115 to 130 days on average, while for full ripeness this period is from 145 to 175 days in the case of genotypes grown in agroecological conditions of Serbia (Takač and Gvozdenović, 2005).

Seeds are small, flat, kidney-shaped. The weight of 1000 seeds ranges from 4 to 6 g. In seed production, the harvest usually starts 70 days after flowering, when fruits reach full ripeness and acquire a brownish color. Khatun et al. (2009) advise that seeds should be extracted at the optimal time in order for them to have high germination. After fertilization, it takes from 50 to 55 days for seeds to ripen (Chen and Li, 1995). Producers, tending to achieve the highest possible seed yields, often harvest semi-ripe fruits (of white-purple

***Corresponding author:**
Vukašin Popović, Institute of Field and Vegetable Crops, Maksima Gorkog 30, Novi Sad, Serbia, **E-mail:** vukasin.popovic@nsseme.com

Received: 16 July 2021; **Accepted:** 18 January 2022

color), which results in the formation of light and hollow seeds of lower germination capacity.

Taking into consideration the production practice of eggplant, the aim of this study was to determine the effect of ripeness, genotype and the year of production on the germination of eggplant seeds, as well as the quality of eggplant fruits and seeds, with a view to determining the optimal time for fruit harvesting.

MATERIALS AND METHODS

The experiment was conducted across 2017, 2018 and 2019 on the plots of the Institute of Field and Vegetable Crops in Novi Sad, Serbia (Rimski Šančevi, E45°19'52.2"N, 19° 50'10.4"E). Seeds were sown in a greenhouse in the beginning of April. Transplanting to the open field took place in the second half of May by a random block system in five plots (the total of 250 plants per variety or 50 plants of each variety per plot). The distance between rows was 70 cm, and the distance between plants in a row was 50 cm. Fruits of tested eggplants were harvested at three stages: commercial ripeness stage (dark purple skin color), semi-ripe fruits (white-purple or gray-white skin color) and fully ripe fruits (brown-yellow skin color). The rate of reaching commercial ripeness, semi-ripeness and full-ripeness was determined by counting the number of days from the flowering of the first flower to the flowering of half of the flowers in each plot (Table 1). Each flower was marked by a date (Fig. 1).

The research included three eggplant varieties:

1. Serbian variety (Fig. 2) - Serbian early-ripening variety of eggplant, which belongs to the West Asian subspecies *Solanum melongena ssp. occiddentale*. The fruit is oval, dark purple to dark blue, weighing 243 g (commercial ripeness);

Fig 1. A flower marked by date.

Fig 2. Serbian variety.

2. Chinese variety (Fig. 3) - Chinese late-ripening variety of eggplant. The fruit is elongated, shiny, dark purple to black. The average weight of the fruit is 228 g;

Fig 3. Chinese variety.

3. Italian variety (Fig. 4) - Italian medium-late ripening variety of eggplant. The fruit is large, long, purple to dark purple. The weight of the fruit is 315 g.

Fig 4. Italian variety.

Harvested fruits were cut into smaller pieces and left to ferment for three days. After washing and drying, seeds were stored in paper packages (bags), and after 60 days the weight of 1000 seeds and germination (the first count - 7 days and the final count - 14 days) of unprocessed seeds were examined (ISTA rules, 2017).

In addition to morphological and germination analyses, plant material (fruits and seeds) were sampled for biochemical analyses and stored under -20 °C immediately after the harvest. In both fruits and seeds, the total protein content was determined by the Kjeldahl method (crude protein was assessed by the Kjeldahl method using the value of 6.25 as a conversion factor of nitrogen to protein). Total sugar content in fruits was determined by the Luff-Schoorl method, and oil content in seeds was determined by the Soxhlet method, extracting the oil for 8 hours at 70 °C. All results are expressed as % of fresh or dry weight.

The statistical analysis of the experimental results was carried out using the software package Statistica 13 (2015), StatSoft, Inc., Tulsa, OK, USA.

Data on weather conditions (temperature and precipitation) were obtained from the Republic Hydrometeorological Service of Serbia (http://www.hidmet.gov.rs/) (Figs. 5, 6 and 7).

Table 1: The average number of days for a specific ripeness phase of eggplant fruits of tested varieties

Variety	Ripeness phase		
	Commercial ripeness	Semi ripeness	Full ripeness
Serbian variety	30	45	75
Chinese variety	60	75	110
Italian variety	40	55	90

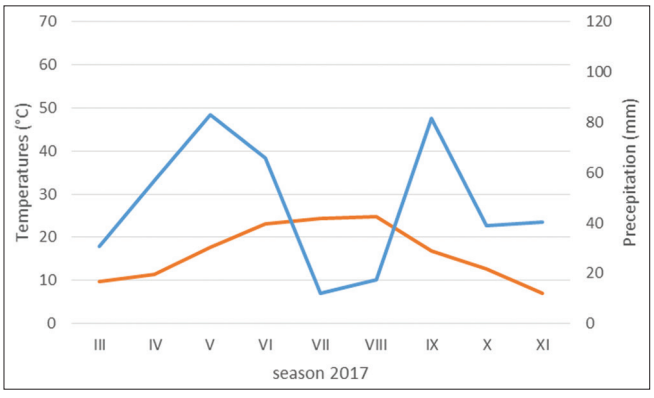

Fig 5. Air temperatures and precipitation in 2017 at the growing site of tested eggplants varieties.

RESULTS AND DISCUSSION

Most researchers consider that, for the purpose of seed production, fruits should be harvested 55 to 60 days after flowering in order to achieve better seed quality (Demir et al., 2002; Rashid and Singh, 2000; Chen, 2001; Yogeesha et al., 2008; Passam et al., 2010a). However, it depends on the variety and season. The average number of days necessary for fruit ripening and counted from the beginning of flowering are presented in Table 1. The Serbian variety ripens 12 days before the Italian variety and 32 days before the Chinese variety. This data clearly indicates that the established differences are varietal characteristics.

The weight of 1000 seeds

Results on the weight of 1000 seeds obtained in this experiment are presented in Table 2. The lowest weight of 1000 seeds was identified in the case of fruits at the stage of commercial ripeness (from 1.45 to 1.74 g). The weight of 1000 seeds extracted from semi-ripe fruits ranged from 2.55 to 2.84 g, while seeds from fully ripe fruits were the heaviest - from 4.16 to 4.42 g (Table 2). These results are in accordance with the ones obtained by Takač et al. (2015).

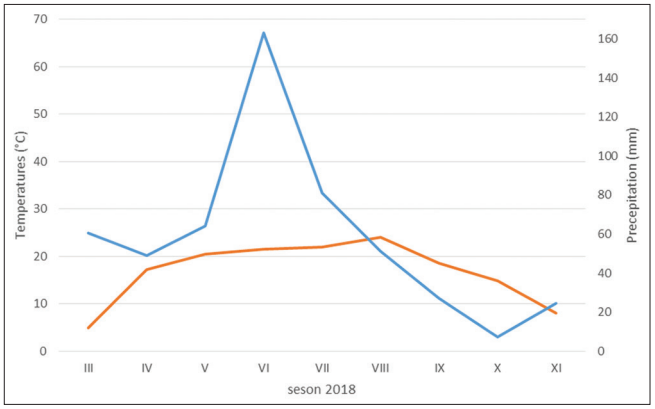

Fig 6. Air temperatures and precipitation in 2018 at the growing site of tested eggplants varieties.

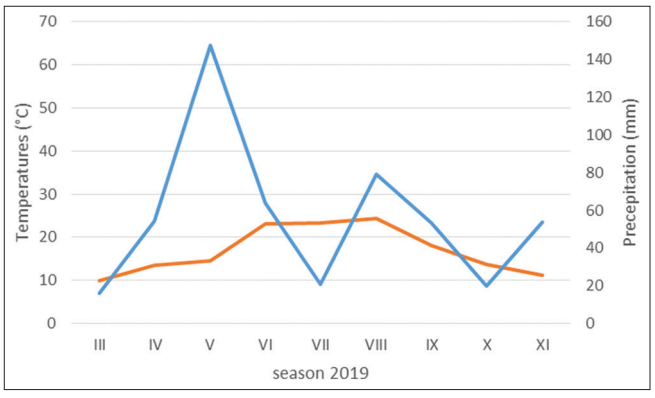

Fig 7. Air temperatures and precipitation in 2019 at the growing site of tested eggplants varieties.

Table 2: The weight of 1000 seeds and germination capacity of three different eggplant varieties in different ripeness phases. A three-year average (2017-2019) ± standard error of mean (SE). The analysis of variance, Fisher LSD test

Variety (v)	Ripeness phase (rp)	The weight of 1000 seeds (g)	Germination	
			First count (%)	Final count (%)
Serbian variety	Commercial ripeness	1.69±0.02	0.00±0.00	0.00±0.00
	Semi ripeness	2.77±0.06	3.00±0.31	4.53±0.46
	Full ripeness	4.42±0.05	65.73±1.05	78.20±0.80
Chinese variety	Commercial ripeness	1.45±0.02	0.00±0.00	0.00±0.00
	Semi ripeness	2.55±0.04	4.07±0.37	5.86±0.42
	Full ripeness	4.16±0.05	71.13±0.70	79.80±0.70
Italian variety	Commercial ripeness	1.74±0.02	0.00±0.00	0.00±0.00
	Semi ripeness	2.84±0.03	2.60±0.31	4.27±0.34
	Full ripeness	4.23±0.04	68.93±0.87	75.13±1.02
CV %		38.47	N/A	N/A
LSD_{rp} (0.01)		0.12	1.51	1.47
LSD_{rp} (0.05)		0.10	1.22	1.18
LSD_{v} (0.01)		0.68	19.73	22.17
LSD_{v} (0.05)		0.55	15.86	17.82

Demir et al. (2002) reported that the weight of 1000 seeds of eggplant ranged from 4 to 5 g and reached its maximum 70 days after fertilization. Similar results were obtained by Passam et al. (2010b) showing that the weight of 1000 seeds extracted from unripe fruits was 1.0 to 2.4 g, while the weight of 1000 seeds extracted from fully ripe fruits was from 4.0 to 5.3 g. Taking into account all the varieties, the weight of 1000 seeds extracted from semi-ripe fruits was 40% higher in comparison with seeds extracted from fruits at the stage of commercial ripeness, while the weight of 1000 seeds extracted from fully ripe fruits was 36% higher in comparison with seeds extracted from semi-ripe fruits.

Seed germination

Eggplant seeds have good germination 45 to 50 days after fertilization, reaching 96.5% to 99.0% (Demir et al., 2002). Germination test results (the first count) showed that seeds extracted from fruits that reached the stage of commercial ripeness did not germinate (Table 2). Seeds extracted from semi-ripe fruits had a low germination percent - in the first count from 2.60% to 4.07% and in the final count from 4.27% to 5.86%, which agrees with the results obtained in the study by Takač et al. (2015).

The highest germination in the first count was recorded in seeds extracted from fully ripe fruits, which means that seeds had fully ripened, as well. The Chinese variety had the highest germination capacity in both counts. The Serbian variety had the lowest germination capacity in the first count, while, in the second count, the variety with the lowest germination was the Italian one (Table 2). Seed germination was significantly affected by the ripeness phase, the variety, the year of production and the ripeness phase-by-the year of production interaction (Table 3). The obtained results point out that the full ripeness phase was the optimal time for harvesting fruits.

The analysis of variance ($\alpha = 0.01$) revealed statistically very significant differences among the values of each of the observed parameters depending on the ripeness phase, the variety and the year of production. The Tukey test showed a significant difference among the values of the aforementioned parameters primarily in regard to the ripeness phase (Table 3).

Total protein content in seeds

Seeds extracted from fruits at the stage of commercial ripeness had the lowest total protein content (from 13.04% to 17.49%) (Table 4). The total protein content in seeds extracted from semi-ripe fruits ranged from 17.17% to 18.15%. The Italian variety had the highest percentage of total protein content in seeds extracted from fully ripe fruits (19.92%). However, the lowest total protein content in seeds extracted from fully ripe fruits was recorded in the Serbian variety (19.10%). This research shows that the biggest change in the total protein content occurred when fruits of the Serbian and Italian varieties entered the phase of semi-ripeness and when fruits of the Chinese variety entered the phase of full ripeness. An interesting observation is that, in the full ripeness phase, the lowest total protein content was established in seeds of the Serbian variety, which, however, had the highest weight of 1000 seeds (4.42 g).

Total oil content in seeds

In the initial stages of fruit development, the total oil content in seeds is the lowest, but it gradually increases during ripening. The total oil content in seeds extracted from fruits at the stage of commercial ripeness ranged from 8.58% to 11.03%, and in those extracted from fruits at the stage of semi-ripeness from 11.52% to 13.42% (Table 4). The highest oil content was identified in seeds extracted from fully ripe fruits of the Italian variety (18.74%), while the lowest oil content was found in the Serbian variety (15.18%). The total oil content was significantly affected by the ripeness phase, the variety, the year of production and the ripeness phase-by-the variety interaction (Table 3). The obtained results do not indicate a relation between the weight of 1000 seeds and the total oil content in seeds in the full ripeness phase. Based on this, it can be concluded that the total oil content in seeds is a varietal characteristic.

Table 3: Mean values and their significance for the weight of 1000 seeds, germination capacity and biochemical parameters (dry weight – dw, fresh weight – fw). The analysis of variance, Tukey test

Treatment	The weight of 1000 seeds (g)	Germination		Total seed protein (% dw)	Total seed oil (% dw)	Total fruit sugar (% fw)	Total fruit protein (% dw)
		First count (%)	Final count (%)				
Commercial ripeness	1,63 c	0,00 c	0,00 c	15,36 c	10,07 c	1,77 a	21,76 a
Semi ripeness	2,72 b	3,22 b	4,89 b	17,68 b	12,38 b	1,27 b	19,50 b
Full ripeness	4,27 a	68,60 a	77,71 a	19,58 a	16,82 a	0,80 c	15,92 c
Serbian variety	2,96 a	22,91 a	27,58 a	16,44 b	11,76 a	1,26 b	18,47 b
Chinese variety	2,72 a	25,07 a	28,56 a	18,32 a	13,66 a	1,01 b	18,50 ab
Italian variety	2,94 a	23,84 a	26,47 a	17,87 a	13,86 a	1,56 a	20,21 a
2017	2,77 a	22,44 a	26,40 a	17,66 a	12,34 a	1,10 b	19,35 b
2018	2,89 a	24,91 a	28,58 a	17,04 a	13,19 a	1,25 ab	16,49 c
2019	2,96 a	24,47 a	27,62 a	17,93 a	13,74 a	1,48 a	21,35 a
Ripeness phase (RP)	**	**	**	**	**	**	**
Variety (V)	**	**	**	**	**	**	**
Year (Y)	**	**	**	ns	**	**	**
RP x V	ns	**	ns	**	**	ns	**
RP x Y	ns	**	**	ns	ns	**	ns
V x Y	ns	ns	ns	ns	ns	ns	**
RP x V x Y	ns	ns	ns	ns	ns	**	ns

** – significance at 0.01 probability level; ns – non significant

Table 4: Biochemical parameters of three different eggplant varieties in different ripeness phases. A three-year average (2017-2019) ± standard error of mean (SE), dry weight – dw, fresh weight – fw. The analysis of variance, Fisher LSD test

Variety (v)	Ripeness phase (rp)	Total seed protein (% dw)	Total seed oil (% dw)	Total fruit sugar (% fw)	Total fruit protein (% dw)
Serbian variety	Commercial ripeness	13.04±0.39	8.58±0.13	1.69±0.02	20.15±0.54
	Semi ripeness	17.17±0.33	11.52±0.12	1.33±0.04	19.31±0.52
	Full ripeness	19.10±0.19	15.18±0.19	0.75±0.03	15.96±0.85
Chinese variety	Commercial ripeness	17.49±0.21	11.03±0.21	1.53±0.10	20.61±0.72
	Semi ripeness	17.73±0.19	13.42±0.28	0.92±0.01	19.62±0.66
	Full ripeness	19.73±0.21	16.54±0.33	0.60±0.04	15.26±0.52
Italian variety	Commercial ripeness	15.55±0.35	10.61±0.14	2.09±0.08	24.53±0.59
	Semi ripeness	18.15±0.26	12.22±0.13	1.55±0.08	19.56±0.49
	Full ripeness	19.92±0.22	18.74±0.47	1.05±0.01	16.54±0.52
CV %		13.05	24.24	39.64	18.55
LSD_{rp} (0.01)		0.93	0.92	0.19	1.60
LSD_{rp} (0.05)		0.75	0.74	0.16	1.29
LSD_{v} (0.01)		1.33	1.88	0.28	2.13
LSD_{v} (0.05)		1.07	1.51	0.23	1.72

Total sugar content in the fruit

San José et al. (2014) recognized differences in fruit sugar content at the stage of commercial ripeness of various genotypes depending on the method of cultivation and the season. The total sugar content in fruits harvested in the phase of commercial ripeness was from 1.53% to 2.09%, while in semi-ripe fruits it ranged from 0.92% to 1.55% (Table 4). Fully ripe fruits had the lowest total sugar content (from 0.60% to 1.05%). It can be concluded that the total sugar content in fruits of the examined varieties decreases during ripeness. These results indicate that, in each phase of ripeness, fruits of the Chinese and the Italian varieties have the highest and the lowest total sugar content respectively. The total sugar content in fruits was significantly affected by the ripeness phase, the variety, the year of production and the interaction between the ripeness phase and the year of production as well as the interaction among the ripeness phase, the variety and the year of production (Table 3).

Total protein content in the fruit

Fruits reach the highest value of total protein content in the phase of commercial ripeness. The total fruit protein content of the examined varieties decreases during ripening (Table 4), while the total protein content in seeds increases, which means that during ripening, protein passes from the fruit into the seed. The Italian variety had the highest total fruit protein content in the phase of commercial ripeness (24.53%). The research by Raigon et al. (2010) points out that protein content is a varietal characteristic, which agrees with the results obtained in this study. There was noticed a statistically significant difference among the values of the total protein content in fruits depending on the ripeness phase, the variety, the year of production and the interaction between the ripeness phase and the variety as well as between the variety and the year of production (Table 3). This suggests that the total protein content in fruits does not only depend on the variety. It is also significantly affected by the ripeness phase as well as conditions in the year of production.

CONCLUSION

This research of eggplant seeds and fruits is important in terms of optimizing the time of fruit harvesting and extracting fully ripe seeds of high germination. The optimal ripening of the fruit enables the extraction of quality seeds and their simpler and more economical processing. The obtained results showed that seeds extracted from fruits in the phase of commercial ripeness did not germinate, while those extracted from fully ripe fruits had the highest germination. Results obtained in this study indicate that there is a relation between the weight of 1000 seeds and the weight of fruits, but no relation between the weight of 1000 seeds and germination capacity or the total protein and oil content in seeds. As the fruit ripens, its total sugar and protein content decreases, while the reverse is detected for the total protein and oil content of seeds. The presented results could be of great importance in eggplant seed production contributing to higher and more stable yields. Much more attention should be paid to this very interesting topic in further research.

Confilict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Authors' contributions

Vukašin Popović: Conceptualization, conducted experiments, methodology, formal analysis, investigation, writing – original draft, visualization, supervision.
Slavoljub Lekić: Co-supervised the work.
Biljana Kiprovski: Analysis of biochemical parameters.
Adam Takač: Co-supervised the work.
All authors read and approved the manuscript.

REFERENCES

Bhaduri, S. 1951. Inter-relationship of the tuberiferous species of *Solanum* with some consideration on the origin brinjal (*Solanum melongena* L.). Indian J. Genet. Pl. Br. 11: 75-82.

Chen, N. C. and H. M. Li. 1995. Cultivar and seed production of eggplant. In: Training Workshop on Vegebtable Cultivation and Seed Production Technology. AVCRD, Tainan, Taiwan, pp. 1-12.

Chen, N. C. 2001. Eggplant seed production. AVRDC International Cooperators' Guide. Asian Vegetable Research and Development Center, Shanhua, Taiwan.

Demir, I., K. Mavi, T. Sermenli and M. Ozcoban. 2002. Seed development and maturation in aubergine (*Solanum melangena* L.). Gartenbauwissenschaft. 67: 148-154.

Esteban, R. M., E. M. Mollá, L. M. Robredo and F. J. López-Andréu. 1992. Changes in the chemical composition of eggplant fruits during development and ripening. J. Agric. Food Chem. 40: 998-1000.

FAO. 2019. FAOSTAT. Food and Agriculture Organization of the United Nations, Rome, Italy. Available from: http://www.fao.org/faostat/en [Last accessed on 2021 May 20].

ISTA. 2017. International Seed Testing Association. Available from: https://www.seedtest.org [Last accessed on 2021 May 20].

Karihaloo, J. L. and L. D. Gottlieb. 1995. Allozyme variation in the eggplant, *Solanum melongena*, L. (*Solanaceae*). Theor. Appl. Genet. 90: 578-583.

Kaur, C., S. Nagal, J. Nishad, R. Kumar and Sarika. 2014. Evaluating eggplant (*Solanum melongena* L.) genotypes for bioactive properties: A chemometric approach. Food Res. Int. 60: 205-211.

Khatun, A., G. Kabir and M. A. H. Bhuiya. 2009. Effects of harvesting stages on the seed quality of lentil (*Lens culinaris* L.) during storage. Bangladesh J. Agril. Res. 34: 565-576.

Khan, R. 1979. *Solanum melongena* and its Ancestral Forms. In: J. G. Hawkes, R. N. Lester and A. O. Skelding (Eds.), The Biology and Taxonomy of the *Solanaceae*, Academic Press, London, United Kingdom, pp. 629-635.

Lester, R. N. and S. M. Z. Hasan. 1991. Origin and domestication of the brinjal eggplant, *Solanum melongena*, from *S. incanum*, in Africa and Asia. In: J. G. Hawkes, R. N. Lester, M. Nees and N. Estrada (Eds.), Solanaceae III. Taxonomy, Chemistry, Evolution, Richmond, Royal Botanic Gardens, Kew, United Kingdom, pp. 369-387.

Li, H. L. 1969. The vegetables of ancient China. Econ. Bot. 23: 253-260.

Martínez-Ispizua, E., Á. Calatayud, J. I. Marsal, R. Mateos-Fernández, M. J. Díez, S. Soler, J. V. Valcárcel and M. R. Martínez-Cuenca. 2021. Phenotyping local eggplant varieties: Commitment to biodiversity and nutritional quality preservation. Front. Plant Sci. 12: 1-21.

Mennella, G., R. Lo Scalzo, M. Fibiani, A. D'Alessandro, G. Francese, L. Toppino and G. L. Rotino. 2012. Chemical and bioactive quality traits during fruit ripening in eggplant (*S. melongena* L.) and allied species. J. Agric. Food Chem. 60: 11821-11831.

Niño-Medina, G., D. Muy-Rangel, A. Gardea-Béjar, G. González-Aguilar, B. Heredia, M. Báez-Sañudo, J. Siller-Cepeda and R. Vélez De La Rocha. 2014. Nutritional and nutraceutical components of commercial eggplant types grown in Sinaloa,

Mexico. Not. Bot. Hortic. Agrobot. 42: 538-544.

Passam, H. C., S. Theodoropoulou, T. Karanissa and I. C. Karapanos. 2010a. Influence of harvest time and after-ripening on the seed quality of eggplant. Sci. Hortic. 125: 518-520.

Passam, H. C., D. Makrogianni, F. Gregoriou and I. C. Karapanos. 2010b. The size and germination of eggplant seed in relation to fruit maturity at harvest, after-ripening and ethylene application. Analele Univ. Oradea Fasc. Biol. 17: 225-229.

Quamruzzaman, A. K. M., A. Khatun and F. Islam. 2020. Nutritional content and health benefits of bangladeshi Eggplant cultivars. Eur. J. Agric. Food Sci. 4: 1-7.

Rashid, M. A. and D. P. Singh. 2000. A Manual on Vegetable Seed Production in Bangladesh. AVRDC-USAID-Bangladesh Project, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Bangladesh.

Raigon, M. D., J. Prohens, J. E. Muñoz-Falcón and F. Nuez. 2008. Comparison of eggplant landraces and commercial varieties for fruit content of phenolics, minerals, dry matter and protein. J. Food Compos. Anal. 21: 370-376.

Raigon, M. D., A. Rodriguez-Burruezo and J. Prohens. 2010. Effects of organic and conventional cultivation methods on composition of eggplant fruits. J. Agric. Food Chem. 58: 6833-6840.

Republic Hydrometeorological Service of Serbia. 2021. Available from: http://www.hidmet.gov.rs [Last accessed on 2021 Oct 01].

San José, R. S., M. C. Sánchez-Mata, M. Cámara and J. Prohens. 2014. Eggplant fruit composition as affected by the cultivation environment and genetic constitution. J. Sci. Food Agric. 94: 2774-2784.

Statistica 13. 2015. StatSoft, Inc., Tulsa, Oklahoma, USA.

Takač, A. and Đ. Gvozdenović. 2005. Plavi Patlidžan. Partenon, Beograd, Serbia.

Takač, A., V. Popović, S. Glogovac, V. Dokić and D. Kovač. 2015. Effects of fruit maturity stages and seed extraction time on the seed quality of eggplant (*Solanum melongena* L.). Ratarstvo Povrtarstvo. 52: 7-13.

Vavilov, N. I. 1951. The Origin, Variation, Immunity and Breeding of Cultivated Plants. Walthmz, Mass.: The Chronica Botanica Co., Stechert, Inc., New York.

Wang, L., J. Li, J. Zhao and C. He. 2015. Evolutionary developmental genetics of fruit morphological variation within the Solanaceae. Front. Plant Sci. 6: 1-10.

Yogeesha, H. S., T. H. Singh and L. B. Naik. 2008. Seed germination in relation to seed development in eggplant (*Solanum melongena* L.). Indian J. Agric. Sci. 78: 1010-1012.

Zaro, M. J., S. Keunchkarian, A. R. Chaves, A. R. Vicente and A. Concellón. 2014. Changes in bioactive compounds and response to postharvest storage conditions in purple eggplants as affected by fruit developmental stage. Postharvest Biol. Technol. 96: 110-117.

Zeven, A. C. and P. M. Zhukovsky. 1975. Dictionary of Cultivated Plants and Their Centres of Diversity, Excluding Ornamentals, Forest Trees and Lower Plants. Centre for Agricultural Publishing and Documentation, Wageningen, Netherlands.