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Evaluation of hull-less seeded pumpkin lines for growth, yield and quality traits under subtropical conditions

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ABSTRACT

Hull-less seed is an important trait to use as snacks and oil of pumpkin seeds. The present investigation was undertaken with the objective to evaluate the advance breeding lines for growth, yield and quality traits of hull-less seeded pumpkin at PAU, Ludhiana. Experiment was conducted in the Department of Vegetable Science during 2014 and 2015 involving 25 genotypes. A wide range of genetic differences was observed for vine length (28.56 to 175.38 cm), days to 50% flowering (19.17 to 35.17) and days to harvest (58.00 to 77.00). Fruit yield ranged from 44.47 to 552.79 q/ha and seed yield from 1.84 to 8.35 q/ha. Quality traits like oil content (16.66 to 38.67%), dry matter (93.41 to 95.71%), crude fibre (2.33 to 8.00%), total ash (4.00 to 6.33%), protein (1.25 to 2.61%), total sugars (3.19 to 7.47%) and starch (1.66 to 10.90%) also showed considerable differences. Two years evaluation revealed that PWT-2, PWT-4, PWT-8, PWT-10, PWT-20, PWT-43 and PWT-44 were the promising. PWT-4 gave the highest seed yield (8.35 q/ha), oil content (38.67%), oil yield (3.44 q/ha), total sugars (5.67%) and fruit yield (291.9 q/ha). PWT-4 also gave good size of seed (9.27g/100 seeds), protein (2.27%) and starch (4.4%) contents. All these seven genotypes were significantly at par among themselves; however, PWT-4, PWT-20, PWT-10 and PWT-8 were better than check variety Lady Godiva for hull-less seed yield. Therefore, these genotypes can further be evaluated for yield, oil content and quality parameters for commercial release.

Key words: Fruit yield, hull-less seed, pumpkin, oil content, seed yield.

INTRODUCTION

Cucurbita genus (2n = 40) belongs to family Cucurbitaceae and comprised of five domesticated species (Hadia *et al*., 13). All these species are native of Americas (Whitaker, 26) and *Cucurbita pepo* found to be most variable among all (Paris and Nerson, 18). Pumpkins are mostly referred to cultivars having round fruits and used upon maturity for baking or feeding livestock, whereas, squashes to those having edible immature fruits. The seed of most cultigens of *Cucurbita pepo* possess a thick and leathery outer layer (Latifi *et al*., 16). However, a mutant called Styrian (hull-less) seed pumpkin (*Cucurbita pepo* subsp. *pepo* var. *styriaca*) lack complete lignifications of the testa, which makes it cost effective by evading expensive decorticating process. This mutant was emerged in 1880's in the South-East of the Astro-Hungarian Monarchy (Zraidi *et al*., 23). It is controlled by single recessive gene and led to a very thin outer hull (naked or hull-less seeds), as a result pumpkin turned into a snack and oilseed crop in Europe and USA (Idouraine *et al*., 14). Pumpkin seeds have a malleable, chewy texture and a subtly sweet, nutty flavour. Seed possess valuable dietary and medicinal qualities besides being a source of good-quality edible oils. Pumpkin seed extract has been reported to have anti-diabetic, anticancer, anti-mutagenic and antioxidant activities. Keeping in view the significance of oil and nut industry, this mutant was introduced in India and transferred into local genotypes. The advance breeding lines carrying hull-less seed trait were stabilized for growth, yield and quality. Therefore, present investigation was undertaken with the objective to evaluate the advance breeding lines for growth, yield and quality traits of hull-less seeded pumpkin.

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MATERIALS AND METHODS

The experiment was carried out for two consecutive years during summer season of 2014 and 2015 at PAU, Ludhiana. The experimental material comprised of 23 advance breeding lines (F_5 & F_6) of hull-less seeded pumpkin along with check varieties PCK-1 (hulled) and Lady Godiva (hull-less). These lines are derived from across of PCK-1 x Lady Godiva and an unknown snack seeded F_1 hybrid introduced from the USA. Seeds of 25 entries were sown on 5 February during 2014 and 12 February during 2015 in plug-trays. Upon attaining proper size seedlings were transplanted in the field by accommodating ten plants per replication of each genotype at 0.45 m distance between plants on both sides of 1.5 m wide beds. The experiment was laid out in randomized block design suggested by Snedecor and Cochran

(20) with three replications. Other cultural practices were followed as per PAU Package of Practices for the pumpkin (Anon, 3). The observations were recorded on different quantitative and quality traits, *viz.* vine length (cm), days to 50% flowering, node of first female flower, internodal length (cm), fruit shape index, flesh thickness (cm), days to harvest, number of fruits per plant, average fruit weight (kg), fruit yield per hectare (kg/ ha), No. of seeds per fruit, 100-seed weight (g), seed yield per hectare (g/ ha), oil content (%), dry matter (%), ash content (%), carbohydrates (%), protein (%) and fibre content (%). Oil content was estimated using method given by Folch *et al.* (11) and protein content, carbohydrates, total sugars and starch content following standard methods. Dry matter and ash content were determined by recommended methods (AOAC, 4). The level of significance was compared with the introduced variety Lady Godiva of hull-less seeded pumpkin.

RESULTS AND DISCUSSION

The results for growth and yield parameters given in Table 1 depicts that most of the genotypes were dwarf in nature having bush type growth habit. There were 19 genotypes significantly shorter in vine length than check variety Lady Godiva, which was trailing in nature. Bush types are preferred over vine type to accommodate more number of plants, early

Table 1. Performance of different hull-less seeded genotypes for growth and yield parameters.

Genotype	Vine length (cm)	Days to 50% flowering	Node of 1st female flower	Internodal length (cm)	Fruit shape index	Flesh thickness (cm)	Fruit cavity (cm)	Days to harvest	No. of fruits/ plant	Av. fruit wt. (kg)	Fruit yield (q/ha)	Seed yield (q/ha)
PWT-2	107.65*	25.00	7.67	5.10	0.96	1.45	8.92	64.50	2.16*	0.57	381.39*	6.52
PWT-3	61.82*	34.33	8.17	2.62*	0.72	1.55	12.37*	73.67	1.00	0.53	162.13	4.14
PWT-4	47.61*	32.33	5.33*	2.08*	0.63	1.78*	6.60	70.50	2.83*	0.42	294.95*	8.35*
PWT-8	69.02*	33.00	5.17*	3.07*	0.94	1.32	7.90	72.67	2.83*	0.32	267.12	7.71*
PWT-10	35.83*	28.50	5.83	2.27*	0.94	1.78*	9.02	67.50	1.83	0.55	384.81*	7.90*
PWT-11	57.33*	19.33*	7.17	3.26*	1.75*	1.45	6.72	58.00	1.83	0.58	346.72*	7.28
PWT-12	72.31*	35.17	7.33	4.52	1.44*	1.55	8.15	76.00	2.00	0.62	323.28*	6.43
PWT-15	175.38	24.17	7.17	6.87	1.00	1.20	8.65	63.33	1.83	0.21	147.97	5.17
PWT-16	110.25*	27.50	7.83	4.50	0.92	1.50	9.23	65.67	1.83	0.52	338.42*	6.32
PWT-17	108.02*	24.50	7.00	2.11*	1.26*	1.60	6.87	62.83	1.50	0.45	284.21*	4.77
PWT-18	41.11*	32.00	7.17	2.82*	1.31*	1.58	6.72	74.00	1.67	0.58	286.65*	7.27
PWT-19	46.18*	34.50	8.33	1.49*	1.02	1.63	8.64	77.00	2.17*	0.42	297.40*	7.66*
PWT-20	31.67*	22.33	6.83	5.22	1.02	1.25	8.13	63.33	2.50*	0.46	358.44*	8.16*
PWT-22	141.19	24.00	6.67	6.76	1.59*	1.42	8.09	64.17	1.83	0.54	249.05	3.39
PWT-23	131.77	21.67	5.83*	5.47	1.30*	1.33	9.38	61.67	1.83	0.55	190.94	7.15
PWT-25	149.04	23.67	8.00	6.34	0.78	1.40	9.13	62.83	1.17	0.53	177.27	3.18
PWT-26	61.89*	25.50	6.67	2.78*	0.94	1.85*	12.17*	65.83	1.00	1.15	391.30*	3.35
PWT-27	93.26*	26.17	6.83	4.29	1.18*	1.23	7.37	65.67	1.83	0.37	226.59	6.32
PWT-33	49.79*	29.00	8.00	2.71*	1.19*	1.70	9.25	66.00	1.83	0.66	317.91*	4.44
PWT-35	73.67*	21.83	7.50	3.15*	0.98	1.52	8.10	59.33*	1.17	0.50	183.13	4.06
PWT-39	59.97*	19.17*	7.50	2.61*	0.93	1.45	9.32	64.00	1.50	0.43	167.50	1.84
PWT-43	28.56*	31.83	8.17	1.57*	1.10*	1.43	8.00	70.67	2.50*	0.45	308.14*	7.52
PWT-44	119.07*	31.33	7.67	4.83	0.82	1.80*	9.67	70.83	2.00	0.94	418.51*	6.57
Lady Godiva	132.22	22.67	7.50	4.59	0.92	1.50	10.47	63.83	1.50	0.52	241.73	5.65
PCK-1	35.87*	23.33	5.17	1.93*	0.48	2.98*	8.12	60.17*	2.50*	0.38	225.61	6.65
$CD_{0.05}$	11.49	2.83	1.11	0.80	0.14	0.20	1.12	2.84	0.53	0.77	33.78	1.87

*Significantly better than check variety Lady Godiva

maturity, high yield and mechanical weed control. It was also observed that most of the genotypes start flowering within one month of transplanting in the field. The internodal length, another important indicator of dwarfness was also found short in majority of the lines compared with check Lady Godiva (4.59). The bush type pumpkins differ from the common trailing varieties by their much-shortened internodes. Node at which 1st female flower appears indicate the days to fruiting and PWT-8 borne it on 5.17th node of the plant. Among the evaluated hull-less lines, PWT-11 and PWT-35 were the earlier to harvest the mature fruits. There was 19 days difference in fruit maturity among the tested lines; therefore, genotypes of variable maturity can be identified from the available material.

Fruit shape index, *viz.* polar and equator diameter ratio determines shape of the fruit. The ratio of 1.00 shows complete roundness, more than 1.1 towards elliptical and less than 0.9 towards flat shape of the fruit. Generally, consumers prefer round fruits and 12 genotypes fall in this category, whereas, PWT-11, PWt-12 and PWT-22 were highly elliptical with 1.75, 1.44 and 1.59 fruit shape index, respectively. Flesh thickness is important for consumption as vegetable and was significantly more in PWT-4 (1.78 cm), PWT-10 (1.78 cm), PWT-26 (1.85 cm), PWT-44 (1.80 cm) and PCK-1 (2.98 cm) than Lady Godiva (1.50 cm). Therefore, such genotypes can be exploited as dual purpose, *viz.* vegetable as well as snack seeded pumpkin. The larger cavity of fruit can accommodates more number of seeds and was maximum in PWT-3 (12.37 cm) followed by PWT-26 (12.17 cm).

Number of fruits is an important trait that contributes toward yield. In present study, seven genotypes were significantly better in fruit number/ plant than the check variety. PWT-4 and PWT-8 borne maximum 2.83 fruits/ plant. Loy (20), Winkler (22) and Bavec *et al.* (7) recorded 1.2 to 3.5 fruits per plant. Fruit weight is another parameter revealing fruit yield and all the genotypes harvested at mature fruit stage were at par with maximum weight in PWT-26 (1.15 kg) and minimum in PWT-15 (0.210 kg). Bavec *et al.* (7) reported 5.1 kg and Cui and Loy (8) 1.0-1.5 kg fruit weight of hull-less seeded pumpkin in different studies. Fruit yield determines the total economic yield potential of a genotype. PWT-44 (418.50 q/ha) was highest in fruit yield followed by PWT-26 (391.30 q/ha) and PWT-2 (381.39 q/ha). Among the genotypes, 14 were significantly better than Lady Godiva for the fruit yield. Keeping in view the significance to use as snacks or oil, seed yield is most important parameter of hull-less pumpkin. In this study, PWT-4 (8.35 q/ha) was having highest seed yield followed by PWT-20 (8.16 q/ha), PWT-10 (7.90 q/ha), PWT-8 (7.70 q/ha) and PWT-19 (7.66 q/ha). All these five genotypes gave significantly better yield than check variety Lady Godiva. Bahlgerdi *et al.* (6) recorded 5.27, Winkler (22) 7.40 to 9.80 and Fruhwirth and Hermetter (12) 5.00-6.00 q/ha seed yield of hull-less seeded pumpkin.

Oil content of hull-less seeded genotypes is one of the most important traits due to its nutritional significance. The results on quality traits in Table 2 depicts that 17 genotypes were at par with Lady Godiva for oil content. Among them PWT-4 (38.67%) had the maximum oil content followed by PWT-15 (38.33%) and PWT-33 (38.33%). However, for oil yield PWT-4 was significantly better than Lady Godiva, with maximum oil yield, *i.e.* 3.23 q/ha followed by PWT-20 (2.58 q/ha), PWT-8 (2.18 q/ha) and PWT-44 (2.08 q/ha). These values depicted high potential for oil yield in hull-less seeded genotypes. Therefore, this stock can also be exploited as oil seed crop along with the snack seeds and as vegetable. The oil content values are in concordance with those of Stevenson *et al.* (21), wherein, it ranged from 9.8-52.1% in different species of *Cucurbita* and from 31.2-51.0% in different varieties of *C. pepo*. Ardabili *et al.* (5) reported 41.59% and Winkler (22) 45.8% average oil content in hull-less seeded pumpkin, whereas, Martinez *et al.* (17) reported oil contents of two naked-seeded *C. pepo* accessions as 35 and 37%. Pumpkin seeds are considered to be rich in protein. Among all the genotypes, 11 were significantly at par for protein content with check variety. In present study, PWT-11 (2.61%) was found to have maximum protein content followed by PWT-16 (2.58%), PCK-1 (2.50%) and PWT-15 (2.43%). The hullless seeds of pumpkin having high level of dry matter can give good storage for use by the snack and oil seed industry. Low moisture content reduces perishability, because higher moisture content may lead to susceptibility for microorganisms. Among all the genotypes, 22 were significantly at par with check variety, where, PWT-8 (95.71%) was found to have maximum dry matter followed by PWT-15 (95.58%) and PWT-2 (95.50%). The content of dry matter is the reciprocal of moisture and can be determined from the level of moisture in the seed. Adeel *et al.* (1) reported 5.9%, Eman and El-Kinawy (10) 6.8% and Jafari *et al.* (15) 4.7 to 5.4% moisture content in pumpkin seeds. Ash content is the index of total mineral in the seeds, which are expected to speed up metabolic processes, improve growth and development. Generally, ash content of seeds is higher than the fruits, which indicated seeds as good source of minerals. In present study, PWT-3, PWT-

Table 2. Performance of different hull-less seeded pumpkin genotypes for growth and yield parameters.

Genotype	Oil content (%)	Oil yield (q/ha)	Protein (%)	Dry matter (%)	Ash content (%)	Total sugars (%)	Starch (%)	Fibre (%)
PWT-2	31.67	2.06	2.39	95.50	5.00	6.10*	9.76	5.00
PWT-3	32.33	1.34	1.58	94.44	6.33	7.09*	6.62	5.33
PWT-4	38.67	3.23*	2.27	94.17	4.67	5.97*	8.80	4.5
PWT-8	28.33	2.18	1.88	95.71	4.33	5.54	2.08	5.33
PWT-10	23.33	1.84	1.91	95.28	5.33	7.28*	6.70	7.33
PWT-11	25.00	1.82	2.61	94.76	5.67	4.33	1.66	5.67
PWT-12	26.67	1.71	1.99	94.49	5.67	4.99	6.04	6.33
PWT-15	38.33	1.98	2.43	95.58	4.67	5.31	10.12	3.00
PWT-16	18.34	1.16	2.58	95.02	4.33	7.47*	8.54	2.33
PWT-17	18.34	0.87	1.67	95.07	5.00	6.27*	4.60	3.67
PWT-18	25.00	1.82	2.39	93.41	5.33	4.94	4.58	4.67
PWT-19	18.33	1.40	2.32	94.7	4.67	5.40	5.74	5.33
PWT-20	31.67	2.58	2.20	94.07	4.67	6.28*	5.90	6.33
PWT-22	18.33	0.62	2.29	93.77	4.67	6.23*	5.06	6.33
PWT-23	21.67	1.55	1.25	94.91	5.67	5.61	5.62	6.33
PWT-25	20.00	0.64	1.82	94.12	4.67	3.54	9.14	7.67
PWT-26	28.33	0.95	1.49	94.00	6.33	5.68	8.80	4.67
PWT-27	30.00	1.90	1.49	94.30	6.33	3.19	10.18	5.33
PWT-33	38.33	1.70	2.35	94.47	6.00	6.99*	10.12	7.00
PWT-35	30.00	1.22	1.60	95.43	4.67	6.27*	9.92	4.33
PWT-39	16.67	0.31	1.30	94.6	4.67	4.87	8.92	4.67
PWT-43	23.33	1.75	2.35	93.56	4.67	5.24	9.86	4.00
PWT-44	31.67	2.08	1.40	94.52	4.00	4.75	10.08	3.00
Lady Godiva	33.33	1.88	2.39	94.68	5.00	3.48	10.90	4.33
PCK-1	21.67	1.44	2.50	93.46	5.33	6.91*	5.64	8.00
$CD_{0.05}$	10.19	0.98	0.36	1.00	NS	2.38	2.04	2.16

*Significantly better than check variety Lady Godiva

26 and PWT-27 were found to have maximum ash content, *i.e.* 6.33%. The results are close enough to the total ash content (6.1%) of seed reported by Adeel *et al.* (1) and Ardabili *et al.* (5) in *C. Pepo* (5.34%), Alfawaz (2) in *C. maxima* (4.59%) and Shobha (19) in *C. mixta* (5.35%). Sugars are used as sweeteners to improve the palatability of foods and beverages and for food preservation. In this study, PWT-16 (7.47%) was found to have maximum sugar content followed by PWT-10 (7.28%) and PWT-3 (7.09%). Among all the genotypes, 11 were significantly better than Lady Godiva for sugar content. Starch is the storage form of carbohydrates in plants. PWT-24 (10.9%) was found to have maximum starch content followed by PWT-27 (10.18%) and PWT-15 (10.12%). However, 10 genotypes were significantly at par with Lady Godiva for starch content. Ardabili *et al.* (5) reported 25% carbohydrate contents in seeds of hull-less seeded pumpkin. Similarly, Adeel *et al.* (1) reported 25% and Elinge *et al.* (9) reported 28% carbohydrates content in seeds of *Cucurbita pepo*. Fibre containing food were known to expand the inside walls of the colon, easing the passage of waste, thus making it an effective anti-constipation, lowers cholesterol level in the blood and reduce the risk of various cancers. PCK-1 a hulled line has maximum (8.00%) fibre followed by PWT-25 (7.67%) and PWT-10 (7.33%). Among all genotypes, thirteen were significantly at par with Lady Godiva for fibre value. The results obtained for crude fibre contents in seeds of pumpkin were higher than 1.0% as reported by Elinge *et al* (9), which was less than the value (14.94%) reported

Table 3. Best performing seven hull-less seeded pumpkin genotypes for different traits.

Genotype	Seed yield (q/ha)	Oil content (%)	Oil yield (q/ha)	100-seed weight (g)	Fibre content (%)	Protein content (%)	Dry matter (%)	Ash content (%)	Total sugars (%)	Starch content (%)	Fruit yield (q/ha)
PWT-4	8.35*	38.67*	3.23*	9.27	4.50	2.27	94.17	4.67	5.97*	4.40	291.90*
PWT-20	8.16*	31.67	2.58	10.17*	6.33	2.20	94.07	4.67	6.28*	5.90	358.43*
PWT-10	7.90*	23.33	1.84	7.63	7.33	1.91	95.28	5.33	7.28*	3.35	381.35*
PWT-8	7.71*	28.33	2.18	6.65	5.33	1.88	95.71	4.33	5.54	2.08	267.12
PWT-43	7.52	23.33	1.75	7.05	4.00	2.35	93.56	4.67	5.24	4.93	304.90*
PWT-44	6.57	31.67	2.08	6.1	3.00	1.40	94.52	4.00	4.75	5.04	418.50*
PWT-2	6.52	31.67	2.06	7.99	5.00	2.39	95.50	5.00	6.10*	4.88	377.50*
Lady Godiva	5.65	33.33	1.88	9.08	7.00	2.39	94.68	5.00	3.48	10.89	241.73
$CD_{0.05}$	1.87	10.19	0.98	0.08	2.16	0.36	0.99	NS	2.38	2.04	45.42

*Significantly better than check variety Lady Godiva

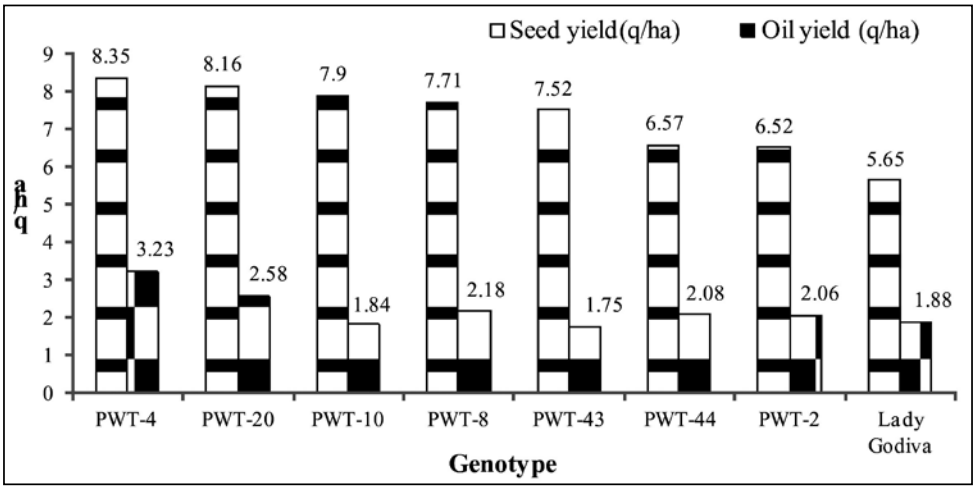

Fig. 1. Performance of best seven hull-less seeded pumpkin genotypes for seed and oil yield.

by Eman and El-Kinawy (10) and near to the value (2.49%) given by Ardabili *et al.* (5) in *Cucurbita pepo*. The fibre content of the pumpkin seeds was reported 2.5% by Adeel *et al.* (1) also.

Based upon seed yield, seven best hull-less seeded genotypes were short-listed and their performance for other quality parameters was compared (Table 3 and Fig. 1). PWT-4 gave highest seed yield (8.35 q/ha), oil content (38.67%), oil yield (3.23 q/ha), sugar content (5.67%) and fruit yield (291.9 q/ha). This genotype also has good size of seed (9.27 g/100 seed), protein content (2.27%) and starch content (4.4%). All these seven genotypes were significantly at par among themselves, but PWT-4, PWT-20, PWT-10 and PWT-8 were better than check variety Lady Godiva for hull-less seed yield. Therefore, these genotypes can further be evaluated for releasing them as varieties.

REFERENCES

1. Adeel, R., Sohail, A. and Masud, T. 2014. Characterization and antibacterial study of pumpkin seed oil (*Cucurbita pepo*). *Life Sci. Leaflets,* **49**: 53-64.

2. Alfawaz, M.A. 2004. Chemical composition and oil characteristics of pumpkin (*Cucurbita maxima*) seed kernels. Food Science and Agriculture Research Center, King Saud University, Res. Bull. 129, pp. 5-18.

3. Anonymous. 2013. *Package of Practices for Cultivation of Vegetables*, Punjab Agricultural University, Ludhiana, pp. 11-12.

4. AOAC. 2005. *Official Methods of Analysis*, Association of Official Analytical Chemists, Washington, DC.

5. Ardabili, A.G., Farhoosh, R. and Khodaparast, M.H.H. 2011. Chemical composition and physicochemical properties of pumpkin seeds (*Cucurbita pepo* spp. *pepo* var. *styriaca*) grown in Iran. *J. Agric. Sci. Tech.* **13**: 1053-63.

6. Bahlgerdi, M., Aroiee, H. and Azizi, M. 2014. The study of plant density and planting methods on some growth characteristics, seed and oil yield of medicinal pumpkin (*Cucurbita pepo* var. *styriaca*, cv. *Kaki*). *American J. Life Sci.* **2**: 319-24.

7. Bavec, F., Gril, L., Grobelnik-Mlakar, S. and Bavec, M. 2002. Seedlings of oil pumpkins as an alternative to seed sowing: yield and production costs. *Die Bodenkultur*, **53**: 39-43.

8. Cui, H. and Loy, J.B. 2002. Heterosis for seed yield exhibited in hull-less seeded pumpkin. **In**: *Cucurbitaceae*, Maynard, D.N. (Ed.), ASHS Press, Alexandria, VA, pp. 323-29.

9. Elinge, C.M., Muhammad, A., Atiku, F.A., Itodo, A.U., Peni, I.J., Sanni, O.M. and Mbongo, A.N. 2012. Proximate, mineral and anti-nutrient composition of pumpkin (*Cucurbita pepo* L.) seeds extract. *Int. J. Plant Res.* **2**: 146-50.

10. Eman, M.H. and El-Kinawy, O.S. 2011. Food toxicology and contaminants. *J. American Sci.* **7**: 615-22.

11. Folch, J., Lees, M. and Sloane-Stanley. 1957. A simple method for isolation and purification of total lipids from animal tissues. *J. Biol. Chem.* **226**: 497-506.

12. Fruhwirth, G.O. and Hermetter, A. 2007. Seeds and oil of the styrian oil pumpkin: components and biological activities. *European J. Lipid Sci. Tech.* **109**: 1128-40.

13. Hadia, H.A., Abdel-Razzak, H.S. and Hafez, E.E. 2008. Assessment of genetic relationships among and within *Cucurbita* species using RAPD and ISSR markers. *J. Appl. Sci. Res.* **4**: 515-25.

14. Idouraine, A., Kohlhepp, E.A., Weber, C.W., Warid, A. and Martinez-Tellez, J.J. 1996. Nutrient constituents from eight lines of naked seed squash (*Cucurbita pepo* L.). *J. Agric. Food Chem.* **44**: 721-24.

15. Jafari, M., Goli, S.A.H. and Rahimmalek, M. 2012. The chemical composition of the seeds of Iranian pumpkin cultivars and physicochemical characteristics of the oil extract. *European J. Lipid Sci. Tech.* **114**: 161-67.

16. Latifi, M., Barimavandi, A., Sedaghathoor, S. and Lipayi, S.R. 2012. Sowing date and plant population effects on seed yield of *Cucurbita pepo. Int. J. Agric. Biol.* **14**: 641-44.

17. Martinez, J.J., Warid, W.A. and Loaiza, J.M. 1996. Improvement of naked seed squash, *Cucurbita pepo* L. **In**: *Cucurbits Towards 2000. Proc. 6th Eucarpia meeting on Cucurbits Genetics and Breeding.* Sonora, Mexico. Gomez-Guillamon, M.L., Soria, C., Cuartero, J., Tores, J.A. and Fernandez-Munoz, R. (Ed.), Graficas Axarquia, Malaga, pp. 66-71.

18. Paris, H.S. and Nerson, H. 2003. Seed dimensions in the subspecies and cultivar-groups of *Cucurbita pepo. Genet. Resour. Crop Evol.* **50**: 615-25.

19. Shobha, B. 2012. Extraction and characterisation of pumpkin (*Cucurbita mixta*) seed oil. *Life Sci. Leaflets*, **7**: 45-49.

20. Snedecor, G.W. and Cochran, W.G. 1967. *Statistical Methods* (6th Edn.), Oxford and IBH Publication Co., Calcutta, 593 p.

21. Stevenson, D.G., Eller, F.J., Wang, L., Jane, J.L., Wang, T. and Inglette, G.E. 2007. Oil and tocopherol content of pumpkin seed oil in 12 cultivars. *J. Agric. Food Chem.* **55**: 4005-13.

22. Winkler, J. 2000. Breeding of hull-less seeded pumpkins (*Cucurbita pepo*) for the use of the oil. *Acta Hort.* **510**: 123-28.

23. Zraidi, A., Pachner, M. and Lelley, T. 2003. On the genetics and histology of the hull-less character of Styrian oil-pumpkin (*Cucurbita pepo* L.). *CGC Rep.* **26**: 57-61.

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