Research Notes

Screening potato wild species for low accumulation of reducing sugars during cold storage

R.S. Meena*, P. Manivel, Vinay Bharadwaj and J. Gopal

Abstract

Tubers of 101 clones of 24 potato wild species were screened for accumulation of reducing sugar during cold storage at 4°C after 3 months of storage. Significant difference in reducing sugar content was observed between and within species. Elite clones with acceptable limit of reducing sugars were identified from different wild species. *Solanum spagazzinii* and *S. sparsipilum* had more number of clones with minimum reducing sugar content after cold storage. Some identified clones with less reducing sugars after cold storage were SS Nos. 564-5, 1301-9, 1636-3, 1648-1, 1671-3, 1686-6, 1724-30, 1724-36, 1724-38, 1724-31, 1724-33, 1725-82, 1725-50, 1725-86, 1725-77, 1725-74, 1725-79, 1725-51, 1725-15, 1725-22, 1725-28, 1725-25, 1725-93, 1725-88, 1725-84, 1725-55, 1725-48, 1725-78, 1725-73, 1725-57, and 1725-90.

Key words: Potato, *Solanum* species, cold storage, reducing sugars

Potato (*Solanum tuberosum* L.) is an important crop in India. The processed products of potato like chips and French fries are now getting more preference in developing countries also. Potatoes need for preparation of such products needs to have some quality parameters like higher dry matter (>22%), low reducing sugars (< 100 mg/100 g fresh tuber weight) and low chip colour (< 3 score on 1-9 scale, 1 being lightest) (Ezekiel *et al*., 2003). Fresh potatoes are very appropriate for processing. But the availability of fresh potatoes throughout the year for the processing unit in our country is a major constrain (Pandey *et al*., 2004). Hence, the processing industries are using potatoes from cold storage during off-season. The problem in using of cold stored potatoes is that during storage the reducing sugar increases rapidly and as a result it produces unacceptable dark colour and/or off-flavoured fired products (Edwards et al., 2002). It is essential, therefore to breed varieties with low accumulation of reducing sugars during cold storage. However, among the cultivated species of potato, *S. tuberosum*, the variability for cold chipping (ability to produce good quality chips after cold storage) is very low and only few germplasm accessions have been identified (Pandey *et al*., 2005). Hence, there is a need to search for the alternate source for reduced sugar accumulation during cold storage so as to use them in the breeding potatoes for cold chipping. Accordingly, some wild species of potatoes were screened to find the variability for reducing sugars content after cold storage and identify the desirable source genotypes.

* Corresponding author, Present address: Scientist (Plant Breeding), National Research Centre for Seed Spices, Pabiji, Ajmere, Rajasthan. 305001
Email: rsm_nrcss@yahoo.co.in

A total of 101 clones of 24 wild species were grown in polyhouse during winter 2004 at CPRI, Shimla (32°N, 77°E and 2500 m amsl). The harvesting was done in the month of February 2005 and tubers were kept in polyethline bags and stored in a walking chamber for 3 months. The temperature and relative humidity maintained during storage period in the walking chamber was 4°C and 95-100%, respectively. After 3 months, the tubers were reconditioned at 20° C for 7 days and analysed for reducing sugar contents. Tubers were cut longitudinally, diced and mixed thoroughly, and 50g of diced tubers were used for determining reducing sugar content following Arsenomolybdate method of Nelson (Nelson, 1944). In all these accessions the reducing sugar was estimated in three replications. The data were analyzed using computer software MSTAT-C.

Significant (P<0.01) difference between genotypes (Table 1) indicating that there was a considerable variation between clones for reducing sugar contents after 3 months in cold storage. The reducing sugar content ranged from 1.05 (SS 1725-82 of *S. spagazzinii*) to 1022.85 (SS 653-3 of *S. stenophyllidium*) mg/100g fresh weight (Table 1). Uppal and Ezekiel (2002) reported the reducing sugar content as high as 1753 mg/100g fresh weight from 3 months cold stored (4° C) tubers of cultivated potato variety K. Badshah. Many accessions of wild species had reducing sugar content lower than that reported for commercial chip production. Twenty out of 48 clones of *S. spegazzinii viz*., SS Nos. 1725-82, 1725-50, 1725-86, 1725-77, 1725-74, 1725-79, 1725-51, 1725-15, 1725-22, 1725-28, 1725-25, 1725-93, 1725-88, 1725-84, 1725-55, 1725-48, 1725-78, 1725-73, 1725-57 and 1725-90; 6 out of 22 of *S. sparsipilum viz*., SS 1724-30, 1724-36, 1724-38, 1724-31, 1724-33 and 1648-1; two out of 7 clones of *S. chacoense,* (SS 564-5 and 1671-3), SS 1636-3 of *S. gomacalyx,* SS 1301-9 of *S. sleumeri,* and SS 1686-6 of *S. tuberosum* sub sp. *andigena* had reducing sugars within the acceptable limit i.e. less than 50mg/100g tuber fresh weight (Kumar *et al*., 2004). However, there was a significant variation between species (Table 2) and clones of within species (Table 1). It may be expected since each individual clone is separate genotype and in heterozygous condition. Among the 24 species studied (Table 2) considerably low mean reducing sugar (<200 mg/100g fresh weight) was observed in *S. gomacalyx, S. Spegazzinii, S. mona, S. S. sleumeri, S. tuberosum* sub sp. *andigena* and *S. sparsipillum.*

Of the 24 species studied, thirteen had only one clone for evaluation and remaining 11 had at least two clones and they were compared and significant difference among the clones within the species (Table 1) was observed. The lowest mean reducing sugar after cold storage was observed in *S. gomacalyx* (41.10 mg/100 g fresh wt.) followed by *S. tuberosum* sub sp. *andigena* (104.78 mg/100 g fresh wt.) and *S. Spegazzinii,* (145.57 mg/100 g fresh wt.). All other species had reducing sugar more than 150 mg/100 g fresh wt. and the maximum mean was in the species *S. stenophyllidium* (724.35) and *S. vernei* (925.2 mg/100g fresh weight).

From the present study it may be concluded that there was a considerable variation for reducing sugar content among clones, accessions as well as between wild species of potato. Thus selection of genotypes with low reducing sugar content for developing cold chipping varieties is possible. The cold chipping accessions identified in the present study could be utilized for potato improvement by broadening the genetic base of the cultivated potato through pre-breeding, as most of the species are diploid with EBN 1-2 and are not readily crossable with cultivated tetraploid potatoes (Thill and Peloquin 1995). The genetically diverse and most promising clones from different species as identified in this study can be exploited in different breeding programmes.

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Table 1. Reducing sugars (RS) content (mg/100 g fr. wt.) in clones after 3 months of cold storage

Species name	SS No.	RS	Species name	SS No.	RS
S. acaula	1668-10	325.35	***S. spegazzinii***	2021-2	558.30
S. acaula	1686-5	893.85	*S. spegazzinii*	2021-1	141.00
S. bulbocastunum	1720	484.80	*S. spegazzinii*	2021-4	239.10
S. chacoense	1808-5	138.00	*S. spegazzinii*	1725-34	270.15
S. chacoense	1808-17	583.50	*S. spegazzinii*	1725-33	96.60
S. chacoense	1671-7	345.90	*S. spegazzinii*	1725-30	80.55
S. chacoense	564-5	12.75	*S. spegazzinii*	1725-27	298.05
S. chacoense	1695-3	141.15	*S. spegazzinii*	1725-25	17.70
S. chacoense	1671-1	187.50	*S. spegazzinii*	1725-24	110.55
S. chacoense	1671-3	14.55	*S. spegazzinii*	1725-16	357.15
S. gomacalyx	1636-3	41.10	*S. spegazzinii*	1725-12	260.25
S. medians	1690-2	200.10	*S. spegazzinii*	1725-4	79.95
S. microdontum	1628-8	201.90	*S. spegazzinii*	1725-3	114.30
S. microdontum	1921-7	667.50	*S. spegazzinii*	1725-44	523.65
S. microdontum	1921-10	552.00	*S. spegazzinii*	1725-43	756.30
S. mona	1659-2	151.80	*S. spegazzinii*	1725-41	292.65
S. multiinterruptum	1396-1	259.95	*S. spegazzinii*	1725-37	139.35
S. oplocense	1401-7	272.55	*S. spegazzinii*	1725-39	254.25
S. oplocense	1401-6	167.70	*S. spegazzinii*	1725-22	15.90
S. phureja	1678-3	455.10	*S. spegazzinii*	1725-17	375.75
S. raphanifolium	1418-3	320.70	*S. spegazzinii*	1725-15	13.65
S. raphanifolium	1418-6	158.40	*S. spegazzinii*	1725-51	13.05
S. raphanifolium	1418-1	96.00	*S. spegazzinii*	1725-86	6.60
S. sleumeri	1301-9	44.40	*S. spegazzinii*	1725-84	29.10
S. sleumeri	1301-1	277.80	*S. spegazzinii*	1725-82	1.05
S. sparsipillum	1664-2	577.05	*S. spegazzinii*	1725-79	12.90
S. sparsipillum	1427-1	202.65	*S. spegazzinii*	1725-78	33.00
S. sparsipillum	1724-33	44.31	*S. spegazzinii*	1725-78	98.10
S. sparsipillum	1724-41	135.75	*S. spegazzinii*	1725-61	99.30
S. sparsipillum	1724-40	202.50	*S. spegazzinii*	1725-28	16.95
S. sparsipillum	1724-39	90.00	*S. spegazzinii*	1725-77	9.00
S. sparsipillum	1724-38	17.70	*S. spegazzinii*	1725-70	94.35
S. sparsipillum	1724-36	14.55	*S. spegazzinii*	1725-72	113.70
S. sparsipillum	1724-31	36.75	*S. spegazzinii*	1725-73	35.10
S. sparsipillum	1724-30	10.07	*S. spegazzinii*	1725-74	11.10
S. sparsipillum	1724-23	226.80	*S. spegazzinii*	1725-93	22.20
S. sparsipillum	1724-22	120.15	*S. spegazzinii*	1725-48	31.35
S. sparsipillum	1724-9	108.45	*S. spegazzinii*	1725-95	186.90
S. sparsipillum	1724-20	311.25	*S. spegazzinii*	1725-50	3.15
S. sparsipillum	1724-16	712.20	*S. spegazzinii*	1725-55	31.20
S. sparsipillum	1724-11	210.45	*S. spegazzinii*	1725-57	35.40
S. sparsipillum	1724-6	192.75	*S. spegazzinii*	1725-54	90.90
S. sparsipillum	1724-5	557.70	*S. spegazzinii*	1725-88	23.25
S. sparsipillum	1664-2	98.70	***S. spegazzinii***	1725-90	48.00
S. sparsipillum	1648-1	49.80	*S. stenotumum*	1680-6	325.95
S. sparsipillum	1725-7	90.45	*S. tarjense*	1459-9	565.35
S. sparsipillum	1725-2	69.45	*S. tuberosum* sub sp. *andigena*	1686-4	155.25
S. spegazzinii	1660-7	132.00	*S. tuberosum* sub sp. *andigena*	1686-6	54.30
S. spegazzinii	1660-5	53.55	*S. vernei*	1592-2	925.20
S. spegazzinii	1660-4	666.60	*S. verrucosum*	2076-6	268.65
S. spegazzinii	2021-9	225.60	**CD(0.05)**		**45.67**

Table 2. Range and mean reducing sugars after 3 months of cold storage in some wild species of potato

Species name	Number of clones studied	Reducing sugars (mg/100g fr. wt.)		Promising accessions with low (50mg/100g tuber fresh weight) reducing sugars
		Mean	Range	
S. acaule	2	609.60	325.35 – 893.85	-
S. bulbocastanum	1	484.80	-	-
S. chacoense	9	281.21	12.75 – 583.50	SS 564-5, 1671-3
S. gomacalyx	1	41.10	-	SS 1636-3
S. medians	1	200.10	-	-
S. membranaceum	1	621.00	-	-
S. microdontum	4	527.29	201.90 – 687.75	-
S. mona	1	151.80	-	-
S. multiinterruptum	2	614.25	259.95 – 968.55	-
S. oplocense	3	209.70	167.70 – 272.55	-
S. phureja	1	455.10	-	-
S. pinnatisectum	1	367.05	-	-
S. pucapishgo	1	603.15	-	-
S. raphanifolium	3	191.70	96.0 – 320.70	-
S. sleumeri	2	161.10	44.40 – 277.80	SS 1301-9
S. sparsipilum	22	195.98	10.07 – 712.20	SS 1724-30, 1724-36, 1724-38, 1724-31, 1724-33 and 1648-1
S. spegazzinii	48	145.57	1.05 – 756.30	SS 1725-82, 1725-50, 1725-86, 1725-77, 1725-74, 1725-79, 1725-51, 1725-15, 1725-22, 1725-28, 1725-25, 1725-93, 1725-88, 1725-84, 1725-55, 1725-48, 1725-78, 1725-73, 1725-57 and 1725-90
S. stenotomum	1	325.95	-	-
S. stenophyllidium	3	724.35	358.65 – 1022.85	-
S. tarijense	1	565.35	-	-
S. tuberosum sub sp. *andigena*	2	104.78	54.30 – 155.25	SS 1686-6
S. vernei	1	925.20	-	-
S. verrucosum	1	268.65	-	-
S. yurgasense	1	314.25	-	-
CD (0.05)		**47.30**		