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VARIABILITY AND SELECTION OF CHESTNUT (*Castanea sativa* MILL.) GENOTYPES IN SRINAGAR DISTRICT OF KASHMIR VALLEY

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The present investigation was carried out with the aim of selection of chestnut types which have superior nut and yield characteristics in Srinagar district of Kashmir province. For this aim, bearing habit, number of nuts per burr, number of plump fruits per burr, nut weight, nut size, pellicle adhesion and intrusion and cropping efficiency were evaluated as per Food and Agriculture Organization Corporate Document Repository and International Union for the Protection of New Varieties of Plants (1989). The following selections were identified for their special quality scores: HSC 032, HSC025, HSC040, HSC018 and HSC022.

Keywords: Chestnut, *Castanea sativa* Mill, weighted-rankit method, Fagaceae, genetic resources

INTRODUCTION

Chestnut (*Castanea sativa* Mill), including several species of the genus Castanea, family Fagaceae, has been playing an important role in the human history. In Kashmir, chestnuts are known as *Panjaeb gour, singhara*. Chestnut grows in the orchards throughout the Himalayas upto Assam and Meghalaya at altitudes of 2000 to 3000m ASL for its edible nuts. The trees have naturalized in India and are doing well throughout the foothills of Himalayas; but are especially grown in Jammu and Kashmir, Kullu, Kangra and Shimla valleys and in the north-western parts of Uttar Pradesh (Anonymous, 1992; Pandit *et al*., 2009). The leading chestnut growing countries in the world are China, Korea, Italy and Turkey. Of the total chestnut production in the world, 71.74 per cent came from China.

Since all the chestnut trees in Kashmir valley are of seedling origin, a wide variability exists in the population as is evident from the chestnuts sold in local markets (Botu *et al*., 1999). These chestnuts vary in terms of taste, colour, shape and peeling characteristics. Within these rich genetic resources, we could find genotypes having high yields, attractive and bright colour, large fruit size and those having less or no pellicle adhesion and intrusion.

Chestnuts can be produced without pesticides and in full accordance with organic principles. This nut has a promise for growing in foothills where other fruit crops cannot be grown. Chestnut is an important resource for its economic and environmental role in agro-forestry system (Burnett, 1998). In Kashmir valley, the profile of fruit industry has been all along dominated by apple. There is pressing need to diversify fruit industry which calls for extension of cultivars of fruit kinds including chestnut. This is possible only when the industry has an access to suitable varietal complex which could be achieved by capitalizing on the diversity available indigenously.

This research aimed at determining the high yielding and good quality chestnut genotypes within naturally grown chestnut populations located in Srinagar district of Kashmir province. In addition, this study may help to preserve the diminishing genetic resources and to obtain quality genotypes which have wider acceptability.

MATERIALS AND METHODS

This research was conducted at three main identified hot spot areas of Harwan, Emporium Garden Lalchowk and Shalimar of district Srinagar in the year 2007-2008. Srinagar district is situated between $35^0$5' – $34^0$7' North latitude and $74^0$8' – $74^0$9' East longitude and at an altitude of 1588 meters above sea level, is flanked by the lofty Himalayan range on south-east and north-east side. During the course of this study, more than 150 plants were evaluated in the selection program. Fruit samples were collected from 30 trees that were grown all over the Srinagar district. As part of the study, fruit samples collected from the trees were evaluated and a selection number was assigned to each selection tree. Fruit samples with burr were collected from each tree. The data was replicated 3 times consisting of 20 fruits per replication. The results for nut weight, number of nuts per burr, kernel ratio, pellicle adhesion, pellicle intrusion, taste, nut yield per tree and total weighted-rankit scores were determined for the chestnut genotypes.

RESULTS AND DISCUSSION

The nut and kernel characteristics for the accessions selected and evaluated during the study are presented in Table 1. Growth habit ranged from spreading to semi-spreading type.

Spreading type of growth habit was common in most of the genotypes, while as semi-spreading growth habit was rare (HSC017, HSC019, HSC035, HSC036, HSC037, SKC044, SKC045, SKC046 and ELC049). Tree vigour ranged from strong to medium with most of the genotypes having strong tree vigour. The lowest petiole length was recorded as 0.93cm in HSC016 and highest 2.76cm in HSC012.

Figure 1. The highest nut weight (16.37g) in selection HSC032

Figure 2. Number of plump fruits/burr (3.26) in selection HSC026

Figure 3. No pellicle adhesion and intrusion in selection HSC012

Bud-burst commenced from 20th March and completed on 7th April. The lowest mean time of bud burst was recorded as 25.0 days in HSC039 and highest was recorded as 34.5 days in SKC046. Initial bloom of male catkins was first observed on 26th April and lasted up to 30th April, whereas full bloom was first observed on 5th May and lasted up to 10th May. Initial bloom of female flowers appeared on 27th May to 30th May, while as full bloom for female flowers appeared on 5th June to 10th June. The results are in line with Mert and Soylu (2006).

The lowest number of burrs per stalk was recorded as 1.00 in HSC036 and the highest number of burrs per stalk as 6.00 in HSC032. Number of plump fruits per burr ranged from the minimum of 1.13 (SKC041) to the maximum of 3.26 (HSC026) whereas number of fruits per burr ranged from the minimum of 2.46 (HSC008) to maximum of 3.60 (HSC026).

In terms of nut weight, genotype HSC032 (16.37g) recorded the highest weight whereas genotype HSC038 (5.23g) recorded the lowest weight. Nut size (mm) in the selections ranged from 25.59 (HSC038) to 34.94 (HSC032). Highest shelling percentage was recorded in selection HSC038 (88.46) and lowest in HSC007 (76.44). Similar results have been reported by Ding (1993) and Kim *et al*. (2005).

Yield per tree ranged from 3kg (ELC049) to 110kg (HSC011) whereas cropping efficiency ranged from 9.84 to 318.40 g/cm^2 in the same selections.

Association among the traits, measured by correlation coefficient revealed highly significant and positive association of the number of burr/stalk with nut yield. Nut size showed positive and significant correlation with nut weight and nut yield. Nut yield showed positive and significant correlation with number of burrs/stalk, nut size and nut weight.

Fruit size was the main criterion considered in the study of chestnut genotype evaluation and selection. On the basis of mean performance with regard to size, accession numbers HSC032, HSC025, HSC040, HSC018 and HSC022 were found best. In chestnut selection studies, yield is also the most important selection criterion. The chestnut yield per tree depends upon number of burrs, the number of fruits per burr, and size of fruit. In general, when the fruit number increases in the burr, the fruit size decreases. Genotype HSC026, HSC018 and HSC022 had highest number of fruits per burr (3.60). Similar findings are reported by Serdar (2002), and Serdar and Soylu (2005).

The peeling off the testa and entrance of testa into the flesh ought to be the main criterion used for selecting chestnuts. This characteristic varied among the genotypes. When the general characteristics observed in this study were considered, it was determined that almost all the selections had a partial pellicle adhesion to the kernel except HSC011, HSC038, HSC032, HSC036, SKC046 and HSC037 where pellicle adhesion was absent. In selection HSC040 there is complete pellicle adhesion and intrusion. Pellicle intrusion

Table 1. Nut and kernel characteristics of various chestnut genotypes

genotypes	Nut Wt (g)	Nut size (mm)	Shelling (%)	Pellicle adhesion	Pellicle intrusion	Yield/tree (kg)	Cropping efficiency (g/cm^2)
HSC001	15.75	33.81	85.46	Partial	No	90.00	196.80
HSC002	10.52	32.22	80.54	Partial	Yes	80.50	181.10
HSC003	10.66	29.82	80.57	Partial	Yes	80.50	181.10
HSC004	6.73	26.21	77.94	Partial	Yes	70.00	162.10
HSC005	11.26	30.48	85.52	Partial	Yes	80.00	174.90
HSC006	15.01	32.94	83.73	Partial	Yes	70.50	168.20
HSC007	9.88	31.27	76.44	Partial	Yes	60.00	144.90
HSC008	13.80	32.56	85.44	Partial	No	70.00	172.20
HSC009	13.68	29.82	83.97	Partial	No	80.00	249.90
HSC010	15.04	30.34	88.25	Partial	Yes	80.50	176.07
HSC011	13.63	32.81	85.25	Absent	No	110.00	318.40
HSC012	8.92	27.99	80.88	Absent	No	75.00	202.20
HSC013	8.02	26.75	81.39	Partial	Yes	76.00	166.20
HSC014	11.09	32.66	81.72	Partial	Yes	75.00	184.50
HSC015	13.68	31.45	85.64	Partial	Yes	80.00	174.90
HSC016	11.09	30.88	80.52	Partial	Yes	75.00	234.30
HSC017	7.04	27.44	77.30	Partial	Yes	50.00	211.60
HSC018	16.10	33.51	85.50	Partial	Yes	75.50	174.80
HSC019	12.15	30.78	85.57	Partial	Yes	50.00	109.30
HSC020	11.15	32.96	82.00	Partial	Yes	50.00	207.20
HSC021	6.15	26.96	77.00	Partial	Yes	45.00	98.42
HSC022	15.63	33.95	84.97	Partial	Yes	80.00	224.90
HSC023	14.80	32.89	85.74	Partial	Yes	80.00	174.90
HSC024	11.74	32.50	86.75	Partial	Yes	70.50	154.10
HSC025	16.27	33.65	85.97	Partial	Yes	65.00	183.30
HSC026	8.82	27.55	79.33	Partial	Yes	100.00	281.20
HSC027	12.58	31.01	84.42	Partial	Yes	80.00	174.90
HSC028	7.85	27.43	77.64	Partial	Yes	70.00	162.10
HSC029	14.65	32.72	86.67	Partial	Yes	70.50	158.60
HSC030	11.82	30.86	88.46	Partial	Yes	60.00	181.70
HSC031	11.42	30.04	87.66	Partial	Yes	50.00	112.40
HSC032	16.37	34.94	85.98	Absent	No	70.00	218.70
HSC033	12.23	33.09	84.00	Partial	Yes	70.00	172.20
HSC034	11.63	30.00	86.33	Partial	Yes	10.00	24.60
HSC035	15.20	33.71	85.33	Partial	Yes	80.00	22.49
HSC036	5.30	25.76	86.41	Absent	Yes	13.00	68.24
HSC037	5.86	26.53	86.16	Absent	Yes	20.00	119.30
HSC038	5.23	25.59	86.68	Absent	Yes	15.00	73.81
HSC039	6.22	26.85	86.33	Partial	Yes	17.00	80.63
HSC040	16.21	33.88	86.27	Complete	Yes	75.00	227.10
SKC041	14.75	33.36	83.11	Partial	Yes	30.00	82.02
SKC042	8.68	27.14	84.40	Partial	Yes	20.00	58.32
SKC043	9.46	26.63	84.00	Partial	Yes	33.00	196.80
SKC044	8.53	26.72	83.61	Partial	Yes	22.00	93.13
SKC045	14.87	33.99	82.20	Partial	Yes	25.00	149.30
SKC046	9.11	31.41	84.14	Absent	Yes	28.00	132.80
ELC047	6.04	26.33	86.83	Partial	Yes	20.00	87.48
ELC048	5.90	26.73	86.34	Partial	Yes	26.00	93.05
ELC049	5.94	27.84	86.70	Partial	Yes	3.00	9.84
ELC050	10.04	27.36	83.86	Partial	Yes	26.00	157.40

Table 2. Estimates of range, mean, standard error and co-efficient of variation of chestnut genotypes

S. No.	Character	Range		Mean±S.E.	C.V (%)
		Minimum	Maximum		
1.	Petiole length	0.93	2.76	1.92±0.04	28.64
2.	Bud burst	25.00	34.00	28.87±0.21	9.07
3.	No. of burrs/stalk	1.00	6.00	3.96±0.12	36.61
4.	No. of plump fruits/burr	1.13	3.26	1.78±0.12	33.14
5.	No. of undeveloped fruits/burr	0.33	1.91	1.11±0.04	46.84
6.	No. of fruits/burr	2.46	3.60	2.89±0.03	15.22
7.	Nut size (mm)	25.59	34.94	30.25±0.25	10.14
8.	Nut weight (g)	5.23	16.37	11.09±0.30	32.18
9.	Shelling percentage	76.44	88.46	83.96±0.53	7.75
10.	Nut yield (kg)	3.00	110.00	57.05±0.73	47.04
11.	Cropping efficiency (g/cm^2)	9.84	318.40	41.02±0.51	41.02

Table 3. Correlation coefficients for different yield parameters in various chestnut genotypes

S. No.	Character	No. of Burrs/ stalk	No. of plump fruits/burr	No. of undeveloped fruits/burr	Nut size	Nut weight	Nut Yield
1.	**Petiole length**	-0.045	0.061	0.394*	-0.178	-0.062	0.229
2.	**No. of burr/stalk**		0.196	-0.0147	0.180	0.206	0.381*
3.	**No. of plumps/burr**			-0.683	-0.043	-0.025	0.135
4.	**No. of undeveloped fruits/burr**				0.099	0.127	-0.121
5.	**Nut size**					0.855*	0.415*
6.	**Nut weight**						0.483*

Table 4. The scores of characteristics and their relative values (Ayfer and Soylu, 1995)

S. No.	Characteristics	Relative score			Class of characteristics & their scores
		General quality	Nut size	Roasting	
1.	**Fruit bearing**	10	10	10	Very good **10**, good **7**, medium **4**, low **1**
2.	**No. of nuts/burr**	10	10	10	3.0-2.5; **10**, 2.4-1.5; **6**, 1.4-1.0; **3**
3.	**Nut size (No. of nuts/kg)**	15	20	15	Very large ≤55; **8**, medium 66-85;**6**, Small 86-100; **3**, very small≥100;**1**
4.	**Pellicle adhesion to kernel**	10	10	15	Absent **6**, Partial **3**, Complete **1**
5.	**Pellicle intrusion to kernel**	10	10	10	No **9**, Yes **1**

Table 5. Characteristics of selected genotypes on the basis of weighted-rankit method

Characteristics		Chestnut types			
		HSCO01	HSCO11	HSCO26	HSCO32
1.	**No. of plump nuts/burr**	2.66	1.60	3.26	2.66
2.	**Nut weight**	15.75	13.63	8.82	16.37
3.	**Pellicle adhesion**	Partial	Absent	Partial	Absent
4.	**Pellicle intrusion**	No	No	Yes	No

was found in most of the genotypes except a few. It was generally observed that most of the selections had a non-adherent integument to the kernel. Hara *et al*. (1995) also reported similar results. When the total value scores determined using the weighted-rankit method for each chestnut genotype were evaluated, genotype HSC026 had the highest score followed by genotypes HSC032 and HSC001.

***Conclusions*:** This study is significant because it is the first selection work in the Srinagar district of Kashmir province. It was concluded that the population provides sufficient variability to select for better types and above mentioned genotypes may be utilized for commercial exploitation and further improvement program of chestnut in the valley as well as other adjoining areas where chestnuts are grown.

However, adaptation studies would be required for the selected chestnut genotypes.

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