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Performance of Cold Stored and Diffuse Light Stored Seeds of Some Indigenous Potato Varieties in Bangladesh

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Abstract: Investigation was carried out at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh during 1992-93 and 1993-94 growing seasons to study the effects of storage conditions of seed tubers on the subsequent crop performance of some indigenous potato varieties. Seed tubers (20-30 mm dia) were stored either in cold storage (6-8°C and 85-90% relative humidity) or in diffuse light storage under thatched house conditions. Plant emergence, percent foliage coverage at 60 DAP and the number of tubers per hill were significantly higher in plants from cold-stored seed tubers. There were no significant effects of storage conditions of seed tubers on plant height and yield of tubers in 1992-93. Seed tubers stored in cold storage produced higher yield in 1993-94. Yield of the indigenous potato varieties differed widely. Also significant interactions were observed among varieties and storage conditions of seed tubers. The results of the two separate experiments in two subsequent years indicate that diffuse light storage of seed tubers in farm-house conditions may be practiced without substantial yield loss of indigenous potatoes in Bangladesh.

Key words: Indigenous potato, seed tubers, cold and diffused light storage conditions

INTRODUCTION

The potato varieties introduced in Bangladesh long ago and adapted to the local conditions are known as indigenous potato varieties (IPVs). The indigenous potato varieties cover nearly 40% of the total area under potato cultivation in this country. Although the yield potential of IPVs is low, the demand and price of IPVs is rather high in the market because of consumers' preference for taste and better keeping quality under ordinary home conditions compared to the modern varieties (Siddique and Hussain, 1988). Unavailability of cold storage and high charges of cold storage direct most of the IPV growers to store their seeds in home storage. Although the use of cold storage for the maintenance of quality seed tubers is well documented, the potentiality of a simple on-farm storage under diffused light conditions for the developing countries in the tropics has been emphasized (Wiersema and Booth, 1985; Severian *et. al.*, 1986; Boucaron and Collett, 1990). Under Bangladesh conditions, a study in this respect was conducted with modern potatoes (Anonymous, 1990). But no reports are available in this connection with IPVs. The present investigation was carried out to study the effects of storage conditions of some seed tubers on the growth and yield of some indigenous potato varieties.

MATERIALS AND METHODS

The study was conducted at the Horticulture Farm, Bangladesh Agricultural University during 1992-93 and 1993-94. The experimental area was a medium high land with sandy loam soil in Old Bramahputra Alluvium. The experimental area enjoys subtropical climate, characterised by heavy rainfall during the months from April to September and scanty rainfall during rest of the months.

During 1992-93 growing season seed tubers (20-30 mm in diameter) of eleven IPVs stored at cold storage at 6-8 °C and 85-90% relative humidity and in diffused light storage under thatched house conditions were planted on 17 November 1992. During 1993-94 growing season seed tubers of seven IPVs stored in the same conditions as above were planted on 22 November 1993. The experiments were carried out in randomized complete block design (RCBD) with three replications. The sizes of the unit plot were 3 m x 2.4 m in 1992-93 trial and 3 m x 3 m in 1993-94 trial. Sprouted tubers were planted in well-prepared plots at a spacing of 60 cm x 15 cm. The crop was fertilized with 20 tons cowdung, 276 kg urea, 185 kg triple super phosphate (TSP), 322 kg muriate of potash (MP), 75 kg gypsum, 25 kg zinc sulphate and 9 kg borax per hectare. Cowdung was applied during final land preparation. Half of the dose of urea and full amount of TSP, MP, gypsum, zinc sulphate and borax were applied in furrows made on both sides of seed rows. The remaining dose of urea was applied at 40 days of planting. Proper care and plant protection measures were taken during the entire period of experiment. The crop was harvested at proper maturity. Data on different growth and yield parameters were collected and analysed.

RESULTS AND DISCUSSION

Seed potatoes of different storage conditions had significant influence on subsequent plant emergence, growth and yield of potato (Table 1 and 2). In general, plants from cold stored seed tubers emerged 2-3 days faster than from diffuse light stored tubers to attain 80% emergence. During 1992-93, the number of days required for 80% plant emergence from cold stored and diffuse light stored seed tubers were 10.9 and 13.8, respectively. During 1993-94 growing season plant emergence was slower requiring 14.0 and 16.5 days for 80% emergence from cold stored and diffuse light stored tubers, respectively. The generally slower plant emergence form the diffuse light stored tubers might be related to lower vigour of the seed materials because of high rate of loss of tuber reserves at high temperature due to higher rate of respiration. Also the sprouts from diffuse light stored seed tubers became tall, lean, thin and etiolated. Also the physiological ageing of the sprouts from diffuse light stored tubers was longer as they sprouted earlier than the sprouts from cold stored seed tubers. In a trial with some Indian potatoes, Bhandal and Naik (1991) observed development of sprout in country stored materials to be thin and etiolated as compared to thick and sturdy sprouts on tubers stored in cold store.

Plant height of IPVs was not significantly influenced by storage condition of seed tubers. During 1992-93 growing season, the number of stem per plant was statistically identical for both types of storage conditions of seed tubers. However, in 1993-94 growing season, the number of stem per plant was significantly higher from diffuse light stored seed tubers compared to tubers stored in cold storage (Table 1). Molbi *et al.* (1989) observed similar increased number of sprouts per tuber and stems per plant when illumination was provided throughout the storage of seed tubers.

Plant foliage coverage at 60 days after planting (DAP) was significantly influenced by the storage conditions of seed tubers during 1992-93 and 1993-94 (Table 1). The higher foliage coverage of the plants at 60 DAP was related to the faster emergence of plants from the cold stored seed tubers. Plant foliage coverage at 80 DAP was not remarkably influenced by the storage conditions of seed tubers although the percent foliage coverage recorded in 1993-94 season was higher in plants from diffuse light stored seed tubers compared to cold stored tubers (Table 1).

Plants raised form cold stored seeds attained to maturity 4-5 days earlier but produced less number of tubers per plant in comparison to the plants from diffuse light stored seeds. During 1992-93 growing season, the yield of tubers was not influenced by the storage conditions of seed tubers. However, in 1993-94 season, plants from cold stored seeds had significantly higher yield of tubers (25.5 t ha^{-1}) compared to plants from the diffuse light stored seed tubers (20.6 t ha^{-1}). The better performance of cold stored seeds in respect of yield of tubers as compared to diffused light natural storage was also reported by pervious workers (Severian *et al.*, 1986; Anonymous, 1990; Bhandal and Naik, 1991).

Storage condition of seed tubers also influenced the size of tubers in the subsequent crops. In general, cold stored seeds produced relatively higher per cent of larger tubers compared to the seeds stored at diffuse light conditions. As observed during 1992-93 growing season, the medium size tubers (20-30 mm), which are commonly suggested seed as whole-tubers, was higher in plants

Table 1: Main effects of storage conditions and varieties on the growth and yield of indigenous potato

	Days to 80% emergence		Average height of plant (cm)		Number of main stem/hill		% foliage coverage at 60 DAP		% foliage coverage at 80 DAP		Average weight of tubers/hill (g)		Number of tubers/ hill		Yield of tubers (t ha^{-1})	
Treatments	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Seed tuber storage																
Cold stored	10.9	14.0	106	43	4.1	3.4	74.0	70.0	92.0	89.0	259	225.0	28.0	19.1	28.8	25.5
Diffuse light	13.8	16.5	107	41	4.2	4.1	70.0	62.0	94.0	91.0	273	186.0	39.0	27.0	29.7	20.6
$LSD_{(0.05)}$	0.54	0.5	ns	ns	ns	0.4	2.3	2.6	ns.0	1.8	ns	19.8	0.54	4.9	ns	0.9
Varieties																
Ausha	10.4	14.2	86	43	3.0	3.8	64.0	58.0	94.0	93.0	303	220.0	24.5	20.9	33.8	23.0
Challisha	12.7	15.3	72	40	4.2	3.6	68.0	63.0	84.0	82.0	268	165.0	35.5	18.0	26.7	18.8
Dohazari Lal	9.5	14.5	113	44	4.2	4.2	81.0	70.0	99.0	98.0	324	212.0	37.5	22.3	36.0	26.8
Festashil	13.9	14.5	128	45	4.0	3.6	74.0	66.0	100.0	100.0	253	244.0	35.5	27.3	28.3	25.2
Hagrai	15.2	-	127	-	4.5	-	75.0	-	100.0	-	146	-	28.0	-	15.7	-
Lalpakri	9.8	14.2	94	42	4.6	3.7	65.0	67.0	89.0	76.0	257	212.0	42.0	19.6	28.6	21.0
Lalshil	14.0	16.8	116	38	4.0	3.6	70.0	66.0	99.0	83.0	213	177.0	39.5	27.8	23.7	19.6
Patnai	13.0	-	122	-	4.0	-	79.0	-	100.0	-	240	-	43.0	-	25.9	-
Shadaguti	11.5	17.3	114	44	4.0	3.7	91.0	66.0	99.0	98.0	285	210.0	38.5	25.6	31.4	26.8
Shilbilati	10.8	-	105	-	6.0	-	66.0	-	85.0	-	207	-	24.5	-	23.3	-
Surjamukhi	15.4	-	99	-	3.1	-	64.0	-	75.0	-	432	-	21.0	-	48.3	-
$LSD_{(0.05)}$	1.27	0.9	11.5	ns	1.13	ns	5.4	4.8	6.7	3.3	52.5	37.0	1.27	5.9	3.54	1.59

S1 = Growing season 1992-93, S2 = Growing season 1993-94, ns = treatments do not differ significantly at p=0.05

Table 2: Combined effects of storage conditions and varieties on the growth and yield of indigenous potato in 1992-93 growing season

	Days to 80% emergence		Average height of plant (cm)		Number of of main stem/hill		% foliage coverage at 60 DAP		% foliage coverage at 80 DAP		Average weight of tubers/hill (g)		Number of tubers/ hill		Yield of tubers (t ha^{-1})	
Variety	CS	DLS	CS	DLS	CS	DLS	CS	DLS	CS	DLS	CS	DLS	CS	DLS	CS	DLS
Ausha	9.7	11.0	94	77	3.6	2.3	68	60	94	93	316	289	22	27	35.7	31.8
Challisha	10.7	14.7	66	78	4.5	3.9	70	65	85	83	218	318	26	45	23.7	29.7
Dohazari Lal	10.0	9.0	116	110	4.2	4.2	83	78	97	100	326	321	38	37	36.8	35.2
Festashil	10.7	17.0	131	125	4.2	3.8	75	72	100	100	269	237	32	39	29.8	26.7
Hagrai	12.0	18.3	133	121	4.4	4.5	78	72	100	100	158	134	23	33	17.3	14.0
Lalpakri	9.3	10.3	71	117	4.0	5.2	63	67	77	100	243	270	26	58	26.8	30.4
Lalshil	13.3	14.7	115	116	3.5	4.4	70	70	98	100	193	233	32	47	21.7	25.7
Patnai	10.7	15.3	123	119	3.8	4.1	80	77	100	100	244	236	34	52	25.8	25.9
Shadaguti	12.0	11.0	115	113	4.0	4.0	92	90	99	99	279	290	35	42	30.3	32.4
Shilbilati	9.0	12.6	107	103	6.0	6.0	68	63	80	89	213	201	26	23	24.1	22.5
Surjamukhi	12.7	18.0	98	100	2.9	3.3	72	55	83	67	393	471	19	23	44.7	51.9
$LSD_{(0.05)}$	1.8		16.2		1.6		7.7		9.5		74.2		1.8		5.0	

CS = Cold storage, DLS = Diffuse light storage conditions of seed tubers, $LSD_{(0.05)}$ = Least significant difference at p=0.05

Table 3: Combined effects of storage conditions and varieties on the growth and yield of indigenous potato in 1993-94 growing season

	Days to 80% emergence		Average height of plant (cm)		Number of of main stem/hill		% foliage coverage at 60 DAP		% foliage coverage at 80 DAP		Average weight of tubers/hill (g)		Number of tuber hill		Yield of tuber (t ha^{-1})	
Variety	CS	DLS	CS	DLS	CS	DLS	CS	DLS	CS	DLS	CS	DLS	CS	DLS	CS	DLS
Ausha	13.0	15.3	41	46	3.4	4.1	60	54	92	95	223	207	17	25	27.3	18.6
Challisha	14.3	16.3	37	43	3.3	3.8	67	58	80	83	203	227	20	16	22.7	14.9
Dohazari Lal	13.3	15.7	44	43	3.6	4.8	75	65	97	98	243	180	20	25	29.8	23.8
Festashil	13.0	16.0	49	41	3.4	3.8	70	62	100	100	263	223	24	31	26.3	24.1
Lalpakri	13.0	15.3	45	39	3.5	4.0	70	63	73	78	243	180	14	25	20.5	21.5
Lalshil	15.7	18.0	39	37	3.4	3.9	70	62	82	83	183	170	19	36	23.4	15.8
Shadaguti	16.0	18.7	47	40	3.2	4.2	73	67	97	98	207	213	20	31	28.6	25.1
$LSD_{(0.05)}$	1.3		10.3		2.0		6.8		4.7		52.4		8.4		2.3	

CS = Cold storage, DLS = Diffuse light storage conditions of seed tubers, $LSD_{(0.05)}$ = Least significant difference at p=0.05

from diffused light stored seeds. In 1993-94 growing season, plants from cold stored seeds, however, produced relatively higher percent of medium size tubers (Fig. 1).

The varieties under study also showed significant variation in plant emergence, subsequent growth and yield of tubers (Table 1). Challisha, Shilbilati, Lalpakri appeared to be early varieties requiring 95-100 days for crop maturity. The variety Ausha was medium late whereas Festashil, Hagrai, Lalshil, Patnai, Shadaguti were late varieties requiring more than 110 days to mature.

Out of eleven varieties tested in 1992-93, Surjamukhi gave the highest yield of tubers (48.3 t ha^{-1}) followed by Dohazari Lal (36.0 t ha^{-1}) and Ausha (33.8 t ha^{-1}). Out of the seven varieties excluding Surjamukhi grown during 1993-94, Dohazari Lal and Shadaguti produced the highest yield (26.8 t ha^{-1}). Size grades of the tubers varied significantly among the varieties. In 1993-94 season, Shadaguti produced the highest percentage (56.7) of medium size (20-30 mm dia) tubers followed by Festashil and Dohazari Lal. The highest percentage (29.5) of large size (>30 mm dia) tubers was recorded in Ausha followed by Challisha and Lalpakri.

There were also significant interactions between storage conditions and varieties on the yield and size grade of tubers. Diffuse light stored tubers of Surjamukhi out yielded (51.9 t ha^{-1}) all other treatment combinations in 1992-93 (Table 2) while the cold stored tubers of Dohazari Lal produced the highest yield (29.8 t ha^{-1}) in 1993-94 growing season (Table 3). During 1993-94, cold stored seed tubers of Ausha produced the highest percentage (30.6) of large tubers (>30 mm) followed by Lalpakri (29.9%) and Lalshil (29.5%), while Shadaguti produced the highest percentage (59.5) of medium sized tubers (20-30 mm) which was followed by the varieties Festashil (59.5%) and Challisha (55.4%). Small size tuber yield was the highest (35.2%) in Lalshil followed by Dohazari Lal (33.4%) and Shadaguti (32.1%) when diffuse light stored seed tubers were planted in 1993-94 (Fig. 1).

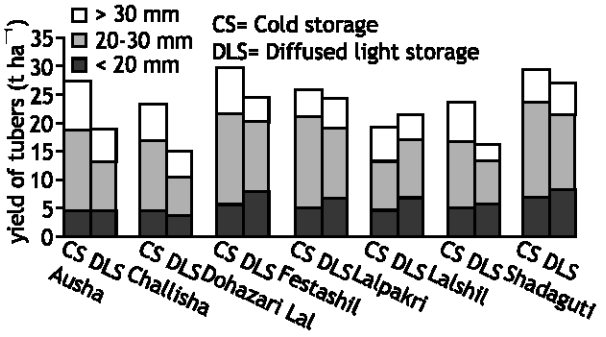

Fig. 1: Yield of different size grade of tubers as influenced by the storage conditions of seed tubers of seven indigenous potato varieties

Again, as regards to the yield of tubers in the subsequent cropping, seed tubers stored in cold store had generally better performance. However, Dohazari Lal, Festashil, Hagrai, Lalpakri, Patnai and Shadaguti were found to have better adaptability to diffuse light storage at ambient temperature without significant reduction in tuber yields of following crop. Seed tubers could be stored in the diffused light storage under farm conditions at substantially reduced costs using potato growers' own facility. Roy and Hossain (1980) suggested a ventilated non-refrigerated storage for economic storing of potato tubers. Many indigenous potato growers in Bangladesh tend to use small size seed tubers, which they store in their farm houses. In case of seed tuber storage in diffused light conditions, planting medium size seed tubers may be useful for successful crop establishment. Zaman *et al.* (1982) reports a combination of 4 months storing in cold store following 4 months storage in diffused light condition is good for maintaining physiologically sound tubers of some modern varieties although economic aspects in this connection is not determined. A non-refrigerated dark storage for a period followed by diffused light storage as suggested by Benz and Fahem (1988) can be an alternative. Further studies covering economic aspects of seed tuber storage and their subsequent performance would lead valuable information for the growers.

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