



## Effect of seed tuber desprouting on subsequent sprouting pattern and production behaviour of potato (*Solanum tuberosum*) cultivars

ASHWANI K SHARMA<sup>1</sup>, R K SINGH<sup>2</sup> and TANUJA BUCKSETH<sup>3</sup>

ICAR-Central Potato Research Institute, Shimla, Himachal Pradesh 171 001

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### ABSTRACT

Potato (*Solanum tuberosum* L.) cultivars are known to vary in their response to desprouting. Removing the apical sprout of the tuber may induce the formation of multiple sprouts thus contributing to a uniformly sprouted tuber that produces several stems per plant. Due to the lack of information on the response of new potato cultivars of Indian hills to desprouting, a study was conducted in north-western hills at ICAR-Central Potato Research Station, Kufri, Shimla (HP), India. The results revealed significant differences in the sprouting pattern of once desprouted and non-desprouted seed tubers. Desprouting of seed tubers about 20 days before planting resulted in more number of sprouts/tuber, shoot and compound leaves per plant and ultimately in higher number of tubers and yield in almost all the cultivars evaluated. The number of seed sized (20-80g) tubers were also significantly more with desprouting.

**Key words:** Cultivar, Desprouting, Genotype, Ground cover, Haulms, Potato, Tuber, Yield

Desprouting is known to affect the sprouting behaviour of seed tubers and subsequently the production performance in some potato (*Solanum tuberosum* L.) cultivars (Dhingra *et al.* 1980, Raj *et al.* 1999, Garg *et al.* 2000). Response of many potato cultivars to desprouting is known and their once or twice desprouting is beneficially practiced in the western countries (Beukema and van der Zaag 1979). Also, once desprouting of seed tubers is recommended as a thumb rule in some common potato cultivars of India like Kufri Jyoti, Kufri Chandramukhi and Kufri Sindhuri for obtaining higher plant density and greater number of seed size tubers on account of more number of stems per plant with desprouting of seed tubers (Dhingra *et al.* 1980, Raj *et al.* 1999). Second desprouting has been reported to be detrimental with respect to vigour and capability of tubers to resprout in most of the potato cultivars (Dhingra *et al.* 1980). However, another potato cultivar of hills, viz. Kufri Giriraj has been reported to be insensitive to even one desprouting (Sharma and Singh 2009). In addition to Kufri Jyoti and Kufri Chandramukhi, which are the oldest but most popular varieties of India (including hills), a good number of new potato cultivars, viz. Kufri Shailja, Kufri Himalini, Kufri Girdhari, Kufri Kanchan and Kufri Himsona are now available for cultivation in the hilly region of India. Most of these cultivars are released for cultivation in the hilly

region of country on account of their resistance to late blight and to avoid the mono-culture of the old but popular potato cultivar Kufri Jyoti with about 30% share in Indian Potato (Luthra *et al.* 2008). The others, viz. Kufri Himsona has been released for processing and Kufri Kanchan on account of its desired skin colour, i.e. red. The new cultivars mainly Kufri Himalini (a day neutral cultivar performing well under long and short days) and Kufri Girdhari (highly resistant to late blight) are gaining popularity among the farmers at a fast pace and the area under their cultivation is expected to increase in due course of time. An attempt was made to see the response of these potato cultivars with regard to production behaviour after desprouting especially on the production of 20-80 g tubers (the most desired grade for seed as well as table purposes).

### MATERIALS AND METHODS

Experiment was conducted in north-western hills of India, at Central Potato Research Station, Kufri (Fagu Unit), Shimla (2700 m msl) during the *kharif* seasons of 2012 and 2013. Six potato cultivars of hills, viz. Kufri Jyoti, Kufri Himalini, Kufri Kanchan (a red skin variety), Kufri Shailja, Kufri Himsona and Kufri Girdhari were evaluated in randomized complete block design (2f) using three replications. From the country stored seed lot of last October harvest, 40-60 g seed tubers were selected and divided into two lots for desprouting (D1) and no desprouting (D0). Each lot in each variety was further divided into three replications with 60 tubers each. To keep a record on number of sprouts, 10 seed tubers in each replication were indexed. Desproutings (D1) was done manually on 10 April and more

<sup>1</sup>Principal Scientist and Head, ICAR-CPRS, Kufri. <sup>2</sup>Principal Scientist and Head (e mail: rjan\_1971@yahoo.co.in), Seed Technology Division, <sup>3</sup>Scientist, Seed technology Division, ICAR-CPRI, Shimla, Himachal Pradesh.

than 3 mm long sprouts were removed. After desprouting, all the tubers (desprouted or non-desprouted) were stored in diffused light under ambient conditions for 20 days (till planting). Planting was done on 30 April, in 3 × 2 m plots at 50 × 20 cm spacing. Standard package of practices were followed for raising the crop and dehauling was done after 120 days of planting.

Data were recorded on indexed tubers at the time of desprouting and also at planting for average tuber weight, number of sprouts and the length of longest sprout per tuber. Observations were recorded on per cent plant emergence after 30, 45 and 60 days after planting (DAP), per cent ground cover after 45, 60, 75, 90 and 105 DAP as well as height, number of shoots and compound leaves per plant at 75 DAP. Ground cover was estimated with the help of a 50 × 50 cm grid with 100 equal compartments at two locations in each plot (Burstall and Harris 1983). After harvesting, the grading of tubers was done into four grades, viz. >150 g, 80-150 g, 20-80 g and <20 g. The total as well as grade-wise number of tubers and yield were recorded. Pooling of the data for two years revealed non-significant interactions (Year × Treatment), so the average of two years data was analyzed statistically in RBD (2f) design by applying the technique of analysis of variance (ANOVA) as described by Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

### *Effect of desprouting on subsequent sprouting behaviour of seed tubers*

*Number of sprouts per tuber:* Data presented in Table 1 reveals that desprouting resulted in a significant increase in the number of sprouts/tuber. Average number of sprouts per tuber at the time of desprouting (2.76 sprouts/tuber) increased to a significant level (3.29/tuber) after 20 days of desprouting. During the same period, number of sprouts/tuber in non-desprouted (control) tubers also

increased significantly from 2.76 to 3.01 sprouts/tuber but still was significantly low to desprouted tubers (3.29). Significant differences were observed among the potato cultivars for number of sprouts per tuber and were maximum in Kufri Kanchan (4.0), followed by Kufri Jyoti and minimum in Kufri Shailja (2.41). Number of sprouts among the remaining three cultivars, viz. Kufri Himalini, Kufri Himsona and Kufri Girdhari were statistically similar to Kufri Shailja. Significant interactions between the desprouting treatment and cultivars reveal that potato cultivars vary significantly in their response to desprouting for sprouting behaviour. Such observations are in conformation to the results obtained by Dhingra *et al.* (1980), Raj *et al.* (1999) and Garg *et al.* (2000) who also reported an improvement in the number of sprouts per tuber in response to desprouting. Increase in number of sprouts per tuber after about 3 weeks of desprouting was due to the development of new eyes into small sprouts and may probably be attributed to the faster mitigation of apical dominance on account of desprouting.

*Length of longest sprout/tuber:* Like number, length of longest sprout was also significantly affected due to desprouting. At planting, length of sprouts was significantly low in desprouted seed tubers in comparison to control (non-desprouted ones). The average length of longest sprout at the time of desprouting was 2.0 cm; which after a waiting period of 20 days increased to 2.2 cm in control (non-desprouted tubers) but was only 0.6 cm in desprouted tubers (Table 1). Significant reduction in sprout length in desprouted tubers over control can be attributed to the fact that all the older sprouts were removed and all fresh sprouts has started emerging, whereas, small increase in the length of existing sprouts in non-desprouted tubers indicates that rate of growth in older sprouts is less in comparison to the new sprouts coming after desprouting. Length of longest sprout also varied significantly among the different potato cultivars and was found to be maximum in Kufri Himsona (2.2 cm) and minimum in Kufri Girdhari (0.5 cm). It

Table 1 Seed tuber characteristics at desprouting and 20 days after desprouting

Cultivar	Average wt./ tuber (g)				No. of sprouts /tuber				Length of longest sprout (cm)			
	At despr.	20 DAD*	Control	Mean	At despr.	20 DAD*	Control	Mean	At despr.	20 DAD*	Control	Mean
Kufri Jyoti	47.9	46.8	46.0	46.9	3.67	3.83	3.60	3.70	2.0	0.7	2.2	1.6
Kufri Himalini	46.8	46.1	46.3	46.4	1.97	3.47	2.17	2.53	2.3	0.8	2.7	1.9
Kufri Kanchan	48.5	46.9	47.1	47.5	3.80	4.43	4.40	4.21	2.0	0.5	2.0	1.5
Kufri Shailja	55.2	53.5	49.6	52.8	2.10	2.60	2.53	2.41	2.3	0.7	2.6	1.8
Kufri Himsona	47.7	45.7	47.8	47.1	2.17	3.03	2.37	2.52	3.1	0.7	2.9	2.2
Kufri Girdhari	45.5	44.6	45.4	45.2	2.83	2.40	3.00	2.74	0.6	0.4	0.7	0.5
Mean	48.6	47.3	47.0		2.76	3.29	3.01		2.0	0.6	2.2	
CD (P = 0.05)												
Cultivars (C)		2.6			0.33			0.2				
Treatments		NS			0.23			0.1				
C×T		NS			0.57			0.4				

\*DAD: Days after desprouting

revealed that among all the potato cultivars evaluated, duration of dormancy in Kufri Girdhari was long under hill conditions. Like wise number of sprouts per tuber, significant interactions between desprouting treatment and potato cultivars revealed that response of desprouting on length of longest sprout was specific to genotype/cultivars.

*Average tuber weight:* Average tuber weight was not affected significantly due to desprouting. Average weight per tuber was significantly different in potato cultivars with maximum in Kufri Shailja (52.8 g), while, it was statistically similar in all the remaining five cultivars (Table 1). Non-significant interaction for tuber weight between desprouting and potato cultivars also revealed that reduction in tuber weight due to desprouting was almost similar among different genotype/cultivars.

#### Per cent emergence

Data on per cent plant emergence after 30, 45 and 60 days of planting (Table 2) reveals that initially (30 DAP) plant emergence was adversely affected due to desprouting. At this stage, emergence was significantly low in desprouted seed tubers than control. Better plant emergence in non-desprouted seed tubers can be attributed to the higher length of sprouts than desprouted ones. On the same lines, among the potato cultivars, per cent emergence at 30 DAP was significantly more in Kufri Shailja (94.3%) and minimum (34.3%) in Kufri Girdhari. With the advancement of time (at 45 days crop age and thereafter), the effect of desprouting was over as plant emergence was almost full in all the treatments. Till 45 DAP, plant emergence was significantly different among the potato cultivars but the differences were over at 60 DAP. Also the interactions between desprouting and potato cultivars were non-significant for plant emergence at 45 DAP and thereafter.

#### Ground cover

Per cent ground cover recorded at 45, 60, 75, 90 and

105 DAP was not affected due to desprouting. However, significant differences were observed among the different potato cultivars up to the crop age of 75 days and thereafter, it was found to be statistically same in all the cultivars. Up to 60 DAP, per cent ground cover was maximum in Kufri Shailja and minimum in Kufri Girdhari. At 75 DAP, a significant increase in the ground cover of Kufri Girdhari was noticed and it was at par to other four cultivars recording the maximum ground cover. At 90 and 105 DAP, ground cover was statistically similar in all the potato cultivars evaluated (Tables 3 and 4).

#### Plant vigour

*Plant height:* Plant height was significantly affected by the desprouting as well as the cultivars. In general, desprouting of seed tubers resulted in a significant increase in the height of plants over non-desprouted ones (Table 4). Among the different potato cultivars, plant height was significantly higher in two cultivars, viz. Kufri Himalini and Kufri Himsona and it was minimum and almost same in Kufri Shailja and Kufri Jyoti. Significant interactions between the desprouting treatment and potato cultivars revealed that the effect of desprouting on plant height was cultivar specific. Variations in plant height due to genotypic differences are already known to exist (Sharma and Singh 2010).

*No of shoots and compound leaves/plant:* Data presented in Table 5 revealed that number of shoots and compound leaves per plant were affected significantly with the desprouting of seed tubers as well as with the genotypes. After desprouting, number of shoots and compound leaves per plant were higher (2.6 and 40.8, respectively) in comparison to non-desprouted tubers (2.2 and 36.4, respectively). Among the cultivars, shoots per plant were significantly higher in Kufri Himsona (2.96) closely followed and at par with Kufri Shailja and minimum in Kufri Girdhari (1.96), whereas, the number of compound leaves per plant

Table 2 Effect of desprouting on per cent plant emergence of potato at different crop stages

Cultivar	% Emergence								
	30 DAP*			45 DAP*			60 DAP*		
	Desp.	Control	Mean	Desp.	Control	Mean	Desp.	Control	Mean
Kufri Jyoti	79.7	92.0	85.8	99.3	99.3	99.3	100	99.3	99.7
Kufri Himalini	80.0	85.3	82.7	100	100	100	100	100	100
Kufri Kanchan	82.7	91.3	87.0	100	100	100	100	100	100
Kufri Shailja	91.3	97.3	94.3	100	100	100	100	100	100
Kufri Himsona	50.0	84.7	67.3	98.0	100	99.0	100	100	100
Kufri Girdhari	28.0	46.7	37.3	98.0	97.3	97.7	100	98.0	99.0
Mean	68.6	82.9		99.2	99.4		100	99.6	
CD (P=0.05)									
Cultivars (C)		6.3			1.1			NS	
Treatments (T)		3.6			NS			NS	
C × T		8.9			NS			NS	

\*DAP: Days after planting

Table 3 Effect of desprouting on per cent ground cover at 45, 60 and 75 days after planting in potato

Cultivar	% Ground cover (45 DAP)			% Ground cover (60 DAP)			% Ground cover (75 DAP)		
	Desp.	Control	Mean	Desp.	Control	Mean	Desp.	Control	Mean
Kufri Jyoti	34.2	38.4	36.3	43.6	51.3	47.5	95.7	98.3	97.0
Kufri Himalini	33.8	32.2	32.9	54.3	45.9	50.2	99.2	95.4	97.3
Kufri Kanchan	34.9	39.7	37.3	55.5	55.7	55.6	99.9	99.8	99.8
Kufri Shailja	39.6	43.2	41.4	57.9	55.8	56.9	98.2	94.9	96.6
Kufri Himsona	29.6	37.8	33.7	51.4	57.0	54.2	81.0	90.8	85.9
Kufri Girdhari	21.4	28.6	25.0	42.6	48.1	45.4	96.8	96.5	96.7
Mean	32.3	36.7		50.9	52.3		95.2	95.9	
CD (P=0.05)									
Cultivars (C)		8.2			3.8			6.7	
Treatments (T)		NS			NS			NS	
C × T		NS			54			NS	

Table 4 Per cent ground cover at 90 and 105 DAP and height per plant as affected by desprouting and cultivars in potato

Cultivar	% G. cover (90 DAP)			% G. cover (105 DAP)			Height/plant (cm)		
	Desp.	Control	Mean	Desp.	Control	Mean	Desp.	Control	Mean
Kufri Jyoti	100	99.7	99.9	100	99.8	99.9	46.6	50.5	48.6
Kufri Himalini	100	100	100	100	100	100	63.5	50.7	57.1
Kufri Kanchan	100	100	100	100	100	100	52.6	47.7	50.2
Kufri Shailja	100	100	100	100	100	100	48.0	46.5	47.3
Kufri Himsona	98.4	99.4	98.9	100	100	100	56.8	55.2	56.0
Kufri Girdhari	100	100	100	100	100	100	52.3	48.7	50.5
Mean	99.7	99.9		100	99.9		53.3	49.9	
CD (P=0.05)									
Cultivars (C)		NS			NS			4.5	
Treatments (T)		NS			NS			2.6	
C × T		NS			NS			6.4	

Table 5 Effect of desprouting of seed tubers on plant vigour characteristics in potato

Cultivar	No. of shoots/plant			No. of compound leaves/plant			Haulms weight/m <sup>2</sup> (Kg)		
	Desp.	Control	Mean	Desp.	Control	Mean	Desp.	Control	Mean
Kufri Jyoti	2.64	2.27	2.46	44.8	42.1	43.4	2.79	2.35	2.57
Kufri Himalini	2.41	2.07	2.24	37.8	31.0	34.4	3.75	3.16	3.45
Kufri Kanchan	2.18	1.93	2.05	35.2	31.9	33.5	2.33	2.24	2.29
Kufri Shailja	3.07	2.62	2.85	45.2	40.4	42.8	1.58	1.17	1.37
Kufri Himsona	3.23	2.69	2.96	46.2	39.9	43.0	2.68	2.63	2.66
Kufri Girdhari	2.08	1.85	1.96	35.9	32.9	34.4	3.78	2.86	3.32
Mean	2.60	2.24		40.8	36.4		2.82	2.40	
CD (P=0.05)									
Cultivars (C)		0.26			2.7			0.63	
Treatment (T)		0.15			1.5			0.36	
C×T		NS			NS			NS	

were maximum and almost same in three potato cultivars, viz. Kufri Jyoti, Kufri Shailja and Kufri Himsona (43 leaves/plant) and minimum in the remaining three cultivars (33 leaves/plant). More number of shoots and thus, compound leaves per plant with desprouted seed tubers can be attributed to the corresponding higher number of sprouts in such seed tubers than control. The results are in general conformity to the findings of earlier workers who have also reported an improvement in number of stems per plant in response to desprouting of potato seed tubers (Raj *et al.* 1999, Singh and Sharma 2008). Interactions between the desprouting treatment and cultivars were found to be non-significant for number of shoots or compound leaves.

**Haulms weight/m<sup>2</sup>:** Haulms weight/m<sup>2</sup> recorded at 120 DAP followed a trend similar to the one followed for number of shoots and compound leaves per plant. It was significantly higher with desprouted seed tubers over control (Table 5). Among the cultivars, haulms weight was maximum in Kufri Himalini (3.45 kg) closely followed and at par with Kufri Girdhari (3.32 kg) and was minimum in Kufri Shailja (1.37 kg). The differences in plant vigour in r/o height, shoots and compound leaves as observed in the present study may be responsible for the differences in the haulms weight to occur. Minimum weight of haulms in Kufri Shailja may also be due to its early maturity.

**Days to foliage maturity:** Days taken to foliage maturity were influenced by desprouting as well as the cultivars but the differences were not more than 2-3 days. Among the different genotypes, three potato cultivars Kufri Kanchan, Kufri Himalini and Kufri Girdhari took maximum time to mature (about 119 days), while, the other three matured little earlier.

#### Tuber number and yield

Desprouting proved beneficial in enhancing the number of potato tubers and yield. Irrespective of potato cultivars, number of tubers and yield were significantly more (339300 and 153.4 q/ha respectively) with desprouted seed tubers than control (305900 tubers and 139.8 q/ha) (Table 6). Among

the cultivars, number of tubers/ha were maximum in Kufri Shailja (422700) and minimum in two cultivars, viz. Kufri Himalini and Kufri Girdhari (about 255000/ha). Similarly, yield (q/ha) was maximum in Kufri Shailja (197.6) closely followed by Kufri Himalini (185.0), but was minimum in Kufri Himsona (79.6). Higher number of tubers and yield with desprouted seed tubers can be attributed to the respective gains in number of sprouts and plant vigour on account of desprouting. The number of sprouts per tuber as well as stems per plant is known to directly affect the tuber number and yields in potato (Raj *et al.* 1999, Singh and Sharma 2008, Sharma and Singh 2009). Significant differences among the cultivars for the number of tubers and yield can be attributed to the varied growth vigour of plants on account of genotypic variability (Sharma and Singh 2010). The interactions between desprouting and potato cultivars were significant for number of tubers per ha but not for yield. It indicates that potato cultivars varied in their response to desprouting for number of tubers but not for yields.

#### Tuber size distribution

The proportions of different grades of potato tubers were affected significantly due to desprouting. Extra large (> 150 g) and large (80-150 g) tubers were significantly low (3.7 and 7.3%, respectively) with desprouted seed tubers than control (6.3 and 12.4%, respectively). Among the potato cultivars, Kufri Himalini had the maximum proportion of extra large tubers (13.0%), whereas, Kufri Himsona did not have any extra large tubers (Fig 1a). Large tubers (80-150 g) were also maximum in Kufri Himalini as well as Kufri Jyoti and minimum in Kufri Himsona (Fig. 1b). Reduction in number of over-size tubers can be attributed to the comparatively more number of tubers obtained with desprouted seed tubers as compared to non-desprouted ones. Earlier workers have also reported reduction in the proportion of oversize tubers with desproutings (Raj *et al.* 1999, Grag *et al.* 2000, Singh and Sharma 2008, Sharma and Singh 2009).

Table 6 Effect of desprouting on days to foliage maturity, total tubers and yield in potato

Cultivar	Days to foliage maturity			Total tubers (000/ha)			Total tuber yield (q/ha)		
	Desp.	Control	Mean	Desp.	Control	Mean	Desp.	Control	Mean
Kufri Jyoti	117.7	112.3	115.0	288.3	262.0	275.2	174.0	157.8	165.9
Kufri Himalini	120.0	117.3	118.7	262.3	249.7	256.0	190.3	179.7	185.0
Kufri Kanchan	119.7	118.3	119.0	391.3	360.7	376.0	128.1	119.4	123.7
Kufri Shailja	117.7	112.3	115.0	457.3	388.0	422.7	210.7	184.6	197.6
Kufri Himsona	113.7	113.0	113.3	364.7	338.0	351.3	82.2	76.9	79.6
Kufri Girdhari	118.3	117.0	117.7	271.7	237.3	254.5	135.3	120.3	127.8
Mean	117.8	115.1		339.3	305.9		153.4	139.8	
CD (P=0.05)									
Cultivars (C)		2.9			14.3			12.4	
Treatments (T)		1.7			8.2			7.2	
C × T		NS			20.2			NS	

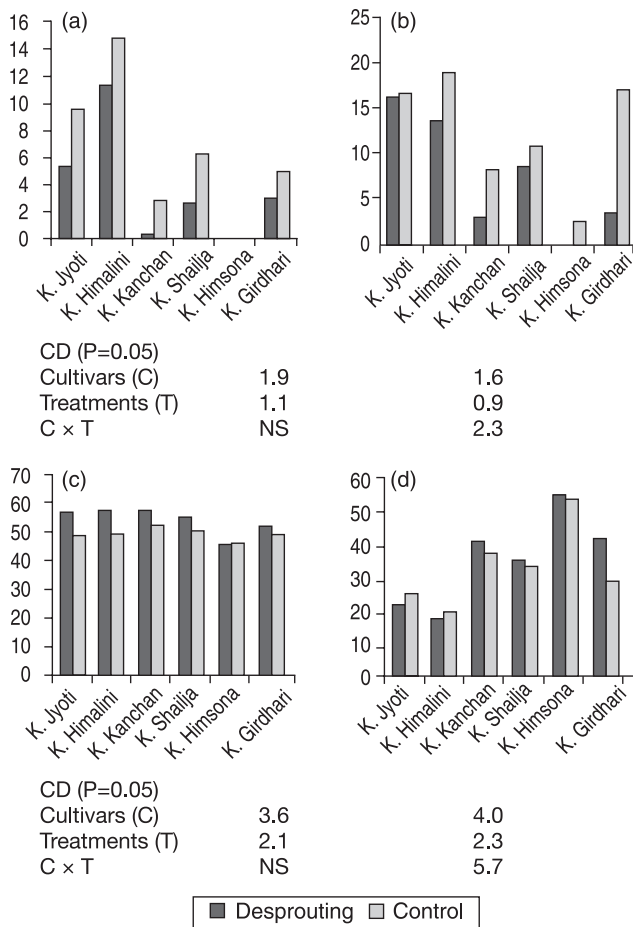


Fig 1 (a-d) Effect of desprouting on the proportion of different grades of potato tubers

Desprouting of seed potato tubers resulted in a significant increase in the proportion of seed size (20-80 g) tubers (Fig 1c). Among the cultivars evaluated, seed size tubers were maximum and almost same in four cultivars but were significantly low in Kufri Himsona. Increase in proportion of seed size tubers due to desprouting has already been reported in Kufri Jyoti (Raj *et al.* 1999, Garg *et al.* 2000). Slightly higher proportions of undersize (<20 g) tubers were also found with desprouted seed tubers than control (non-desprouted) tubers (Fig 1d). Among the potato cultivars, Kufri Himsona had the maximum proportion (53.5%) of undersize (<20 g) tubers, whereas, Kufri Himalini had the minimum (17.9%). Reduction in oversize tubers and an increase in undersize tubers with increasing stem density have already been reported to occur (Guarda and Giulliarri 1983, Sharma and Singh 2010). Getting higher proportion of large size tubers in some cultivars and undersize tubers in others under similar conditions reflects the role of genotypic make up in tuber size distribution as also reported by the earlier workers (Sharma & Singh 2009; 2010). The interactions between desprouting

and potato cultivars were significant for the proportion of large and undersize tubers only. Increase in the proportion of seed size and undersize tubers with desprouting can be attributed to higher number of total tubers obtained with desprouting than control.

From the findings, it can be concluded that once desprouting of seed potato tubers about 20 days before planting is beneficial in all the six cultivars evaluated. It results in more number of sprouts per tuber, shoot and compound leaves per plant and ultimately in higher number of tubers and yield with higher proportions of seed size (20-80 g) tubers. These results have a practical proposition that in almost all potato cultivars of Indian hills except Kufri Giriraj, a single desprouting of seed tubers about 3-weeks before planting can be practiced successfully for obtaining higher number of tubers as well as yields with better tuber size distribution.

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