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ENHANCING GROWTH OF MULTIPLE POTATO VARIETIES USING INNOVATIVE STRATEGIES FOR BREAKING DORMANCY

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ABSTRACT

Potato is the fourth most produced crop globally. Potato yield in Pakistan is low as compared to developed countries. The reasons are limited availability of quality seed and low sprouting due to tuber dormancy. The current study was designed to find a suitable treatment for breaking dormancy in potato tubers that will benefit farmers by enabling precise control over planting and harvest times. In an in-vivo experiment at the Potato Research Institute, Sahiwal, using a complete randomized design with factorial arrangement, applied various treatments, including Thio-urea, gibberellic acid, neem-coated urea, ambient conditions, light, darkness, and varying temperatures to potato tubers of 15 varieties to break dormancy. Biometric evaluation was performed by recording the parameters, including days to first emergence, breaking dormancy, sprouting density, and sprouting length. It was found that Thio-urea had a significant effect on all varieties overall. The varieties Ruby and Ijaz-22 took 6.33 & 7 days to sprout, and 10.14 & 9.58 days to break dormancy, respectively; treatment with Gibberellic acid effectively reduced the dormancy period and stimulated sprouting in all varieties. With this treatment, Ruby broke dormancy in 7.77 days and Satluj in 16.88; the highest sprouting length (8.46) was observed for Kashmir, and the maximum sprouting density (3.56) was recorded for Sialkot-Red. Two treatments showed no meaningful effect, including Neem-coated urea and hot water. Environmental parameters such as ambient conditions (control), darkness, light exposure, and temperature regimes showed varying effects. Current research indicates that thiourea and gibberellic acid is suitable treatments to break dormancy and enhance the sprouting of potato varieties.

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INTRODUCTION

Potato (*Solanum tuberosum* L.) is the fourth most produced crop globally after wheat, maize, and rice. Potato crop gives high yield, high economic returns, and has an excellent nutritional profile. The worldwide total area under potato cultivation was 17,788,408 hectares

in 2022. Globally, China is leading in potato production. In Pakistan, the potato was cultivated on 314125 ha with a total production output of 7936884 tons and a yield of 27.85 t/ha in the year 2022 (FAOSTAT, 2023). Potato yield in Pakistan is low compared to developed countries such as New Zealand, Netherlands, the United States,

France, and Germany Netherlands, the United States, France, and Germany, where they can approach 40t/ha (Majeed and Muhammad, 2018). The dormancy is described as the rest phase during which sprouts fail to emerge from any bud of the tuber, even when the tuber is stored under optimal conditions (Reust et al., 2001). A potato tuber developing a sprout length of at least 2 mm indicates that the dormancy period has ended (Van Ittersum and Struik, 1992). The time of tuber dormancy is determined by multiple factors, i.e., growth environment, potato cultivar, tuber size, and storage period. Moreover, temperature has a notable influence on the occurrence and progression of potato dormancy. It restrains the biochemical and physiological reactions of tubers during this period. Low temperatures can prolong dormancy, but high temperatures might cause premature sprouting (Visse-Mansiaux et al., 2022). Temperature therapy is one of the methods used to break the dormancy period of potato tubers. The most common temperature treatments include high temperature and cold shock with heat. In the high-temperature treatment, the tubers are held in a dark environment at 18–25 °C, until they sprout. In cold shock treatment with heat, the tubers are placed at 4 °C for two weeks or more, followed by storage at 18–25 °C until bud sprouting begins (Deligios et al., 2019). Dark conditions boost potato sprouting, resulting in bud elongation. In contrast, keeping potatoes in low-intensity light reduces photomorphogenesis, slows down bud growth, and prevents tuber senescence (Gong et al., 2021). LEDs can suppress tuber sprouting, reducing physiological ageing in potatoes (Mølmann & Johansen, 2020). When tubers are kept under high humidity (85–90%), dormancy is broken and sprouting is promoted, due to which potatoes are sown in well-hydrated soil (Gong et al., 2021; Mani et al., 2014).

There are several methods for breaking potato dormancy. Sulfur-coated urea named Thio-urea has been used to break the dormancy of potatoes. Thiourea is classified as an enzymatic inhibitor, which plays a vital role in tuber's germination and the emergence of numerous sprouts per potato eye (Germchi et al., 2011). One of the growth-promoting hormones, gibberellins, is used for the rapid replantation of seed tubers that require pathogen testing (Rentzsch et al., 2012). However, gibberellin treatment on dormant tubers is a commercial method for early potato sowing and being used in practical applications. Gibberellins mainly

stimulate the development of active sprouts after the dormant phase of the tuber is broken. Therefore, gibberellins effectively break the dormancy of stored tubers (Draie & Abdul-Mohsen, 2021). Hot water dip (HWT)-treated tubers sprouted at a considerably lower rate (26.0%) than untreated tubers (66.6%).

The objective of the current study is to find the best treatment for breaking dormancy in potato tubers that will benefit farmers by enabling precise control over planting and harvest times.

METHODOLOGY

Model

The research study was carried out from 27th February to 27th May in the laboratory of Potato Research Institute, Sahiwal. The experiment was based on a Complete Randomized Design with a factorial arrangement including three replicates. A total of 15 varieties were tested, of which 12 were locally developed approved varieties of Potato Research Institute, Sahiwal, and 03 were commercial varieties. To break dormancy, 09 different treatments were used including Thio-urea, Gibberellins, Neem-coated Urea, Ambient conditions (Control), Light, Darkness, Temperature at (3°C), temperature at (4-6°C) and hot water. Varieties were taken as the first factor, and treatments as the second factor.

Tuber collection

Freshly harvested tubers of 15 varieties were gathered from the Potato Research Institute, Sahiwal field. A total of 1215 tubers of uniform size and shape, with an average weight of 150 g, were collected. Each treatment consisted of 135 tubers.

Preparation of Solutions

The thiourea solution of concentration (3%) was prepared by dissolving a calculated amount (90 grams) of thiourea granule in 3 liters of distilled water. The gibberellin's solution of 50 ppm was prepared by adding 50 g of gibberellin to 1 liter of distilled water. A 3% neem-coated urea solution was prepared in a similar manner as the urea solution was prepared.

Details of treatments

Potato tubers of 15 varieties were subjected to various dormancy-breaking methods. The total number of treatments was 09. Each treatment involved 135 tubers,

with 3 tubers of the same variety per replicate. In the first treatment, potato tubers were dipped in a 3% thiourea solution for 2 hours and then kept at room temperature. The second treatment used the same methodology but with neem-coated urea. The third treatment involved dipping the tubers in a 50 ppm gibberellic acid solution for 30 minutes and then storing them at room temperature. For the fourth treatment, tubers were placed at ambient conditions (25-30°C) with no dipping treatment. This treatment was taken as control. The fifth and sixth treatments included the exposure of tubers to light and darkness, respectively, with observations recorded over a 2 to 5-week period to determine the effects of light and darkness. The seventh and eighth treatments investigated temperature effects by holding tubers at 3°C and 4-6°C for two weeks before transferring them to room temperature for 2-5 weeks, with weekly measurements. The ninth treatment involved the soaking of tubers in hot water (57°C) for 20 minutes, then air drying and storing at room temperature, with observations taken throughout the experiment.

Biometric Evaluation

Days to the First emergence: The total number of days necessary to cause the appearance of the first sprout was calculated as days to the first emergence. Potato tubers of each treatment were checked each morning to see if any sprouts had emerged. Only the sprout, which attained a length of 2mm, was considered the first sprout from that tuber.

Breaking of Dormancy: It was determined as the total number of days passed after treatment when 80% of the treated tubers had developed at least one sprout of 2mm or longer.

Sprouting length: The sprout's length was measured using a scale with millimetre readings. As the sprout length increased, a scale with centimetre readings was utilized. The average sprout length was monitored at 7-day intervals up to 49 days, beginning with initial sprout initiation on the tuber.

Sprouting density: Sprouting density was determined by counting the total sprouts per tuber and calculating the average sprouting density. The tubers of each treatment were examined at 7-day intervals. The sprouts with more than 2mm length were counted, and the sprouting density was calculated.

Data Analysis

The experimental design was a randomized complete block design with a factorial arrangement. The data was subjected to analysis of variance (ANOVA). The comparison among all the varieties was analyzed by least significant difference (LSD).

RESULTS AND DISCUSSION

Effect of Thio-urea

As depicted in Table 1 Thio-urea treatment showed a significant effect on breaking dormancy of potato tubers of 12 locally developed varieties compared to commercial ones. The genotypic differences among the treated varieties were the main reason for the detected variations. The varieties Ruby and Ijaz-22 took 6.33 & 7 days to sprout and 10.14 & 9.58 days to break dormancy, respectively, after the onset of treatment. Whereas varieties named Sante, SH-5, and Asterix emerged in 13.2, 14, and 12 days, the dormancy was broken in 14, 17, and 13 days, respectively. The findings of this study are endorsed by Ranabhat et al. (2021) as they found 3% Thio-urea solution effectively shortened the dormancy period and improved sprouting behaviour

Effect of Gibberellic acid

Gibberellic acid treatment showed a significant reduction in dormancy period and improved sprouting of 12 locally developed varieties compared to commercial varieties, as shown in Table 2. The variety named Ruby showed first emergence in 7.78 days with a dormancy period of 20.17 days, moderate sprouting density (1.8), and sprouting length (6 cm). The highest sprouting length (8.47cm) was observed for Kashmir. Whereas Satluj required the least days (16.89) to break dormancy. The commercial varieties named Asterix, SH, and Sante took the highest number of days for emergence (37.33 to 38.97 days) and to break dormancy (42.17 to 46.33 days), paired with the lowest sprouting densities (0.703 to 1.227) and sprouting lengths (2.82 to 3.20 cm). The current results coincide with a previous study showing that a concentration of 20 ppm of GA3 effectively broke dormancy and improved sprouting behaviour in potato tubers (Draie and Abdul-Mohsen, 2021).

Effect of Neem-coated urea

After treating the tubers with neem-coated urea, no significant effect was observed in the recorded observations. However, after treatment, the Punjab variety showed sprouting in 26.67 days and dormancy breaking in 31.17

days, with notable sprouting length (5.35 cm) and moderate sprouting density (2.47). Another variety named Sahiwal-White showed a high sprouting density of 3.48 but a shorter sprouting length of 2.23 cm. In contrast, a commercial variety

SH took 24.67 days for sprouting and 29.67 days for dormancy breaking but with low sprouting density (1.37) and sprouting length (2.09). Control varieties such as Asterix and SH sprouted faster (Table 3).

Table 1. Effect of Thio-urea on potato tubers of 15 varieties.

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	10.33	15.35	2.09	5.33
Ruby	6.33	10.14	1.8	6
Sadaf	9.49	13.67	1.89	8.49
Sahiwal-White	8	17.13	1	5.49
Sahiwal-Red	12	16.37	3	4.49
Sialkot- Red	8.75	14.16	4	4.69
Cosmo	8.29	12.93	3.2	6.5
Satluj	9.99	14.43	2.49	7.33
Kashmir	7.49	11.35	4.49	7.87
Punjab	7	11.2	3.49	7.12
Ijaz-22	7	9.58	3.82	5.47
Ravi	9	14.75	3	8.5
Asterix	12	12.55	1	3.2
SH	14	16.96	2	3
Sante	13.2	13.91	1	4
LSD = (0.05)	0.82**	2.48**	0.23***	0.5***
CV %	5.06%	10.86%	5.45%	5.18%
Grand Mean	9.71	13.67	2.57	5.77

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***- significant at 0.1% level of significance

Table 2. Effect of Gibberellic acid on potato tubers of 15 varieties.

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	14.67	17.55	1.64	6.14
Ruby	7.78	20.17	1.8	6
Sadaf	9.83	19.57	1.9	7.5
Sahiwal-White	15.16	18.63	1	6.3
Sahiwal-Red	14.6	19.63	2.89	5.96
Sialkot- Red	13.56	22.2	3.57	4.7
Cosmo	14	19.5	3.26	7.11
Satluj	11.22	16.89	3.09	5.49
Kashmir	12.19	18.6	3.3	8.47
Punjab	14.7	19.23	2.4	7.12
Ijaz-22	15.23	19.5	3	5.47
Ravi	14.87	18.3	2.8	3.63
Asterix	37.33	42.17	0.91	3.2
SH	38.97	44	1.23	3
Sante	38.5	46.33	0.7	2.82
LSD = 0.05	3.63***	2.86***	1.054***	1.822***
CV %	11.97%	7.09%	16.67 %	15.67 %
Grand Mean	18.18	24.17	2.19	5.47

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***- significant at 0.1% level of significance

Table 3. Effect of neem-coated urea on potato tubers of 15 varieties.

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	36	40.67	3.1	3.92
Ruby	36.33	41.67	2.03	2.67
Sadaf	31.65	33.67	2.31	4.03
Sahiwal-White	41	45	3.48	2.23
Sahiwal-Red	38	41	2.47	5.67
Sialkot- Red	42.67	45.33	1.04	4.7
Cosmo	46	49.67	0.66	4.4
Satluj	30.65	35	1.88	2.52
Kashmir	31.65	34.33	1.73	4.03
Punjab	26.67	31.17	2.47	5.35
Ijaz-22	27	35.07	2.64	4.68
Ravi	28	33.33	1.14	3.03
Asterix	25	30.45	0.91	1.1
SH	24.67	29.67	1.37	2.09
Sante	27.67	31	1	2.65
LSD = 0.05	5.069**	4.675**	0.525**	0.896
CV %	8.40%	6.89%	16.75%	14.98%
Grand Mean	36.18	40.73	1.9	3.59

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***- significant at 0.1% level of significance

Effect of Ambient conditions 25-30°C (Control)

Table 4 represents the effect of ambient conditions (25–30 °C) on potato tubers of 15 varieties. Kashmir variety emerged quickly in 29 days, dormancy broke in 34.16 days, exhibited 3.23 sprouting density, and achieved a

suitable sprouting length of 7.35cm. At the same time, commercial varieties such as Asterix, SH, and Sante showed early emergence and a short dormancy period, with low sprouting densities and sprouting lengths as compared to local varieties.

Table 4. Effect of ambient conditions (25-30°C) on potato tubers of 15 varieties.

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	32.83	38.43	0.71	3.9
Ruby	38.83	45	1.38	3.4
Sadaf	37.33	43.33	1.97	4.1
Sahiwal-White	39	50	2.17	5.17
Sahiwal-Red	41	47.2	3.03	2.23
Sialkot- Red	43	53.83	4.63	5.83
Cosmo	46.33	58.13	1.82	1.58
Satluj	37.33	42	3.28	3.47
Kashmir	29	34.16	3.23	7.35
Punjab	33.7	36.1	2.69	7.66
Ijaz-22	37.8	38.23	3.13	5.05
Ravi	31.5	36.7	2.11	3
Asterix	27	26.17	0.69	2.2
SH	22.67	27.6	1.83	2.46
Sante	21.67	27.37	1.72	3.3
LSD = 0.05	4.25**	4.24**	1.42*	1.93**
CV %	7.39%	6.30%	37.64%	29.10%
Grand Mean	34.54	40.34	2.26	3.98

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***- significant at 0.1% level of significance

Effect of Darkness

The darkness significantly affected the dormancy of potato tubers of all 15 varieties. As depicted in Table 5, Sialkot Red, Sahiwal-white, and SH took 8.26, 9.13 & 10.5 days to emergence, respectively. The dormancy breaking periods for the abovementioned varieties were 12.52, 14.05, and 14.33 days, respectively, with average sprouting length and densities. The commercial variety SH exhibited the highest sprouting density (10.47), whereas Ravi showed the highest sprouting length of 13.18cm. The current study aligns with the previous study in which a variety named Tigoni had the highest number of sprouts (9.25) under the effect of darkness, with the most extended sprouting length of 4.63cm (Gachango et al., 2008).

Effect of Light

Table 6 depicts the substantial effect of light on potato tubers of 15 varieties. A significant effect was seen in Sahiwal-Red and Kashmir, which took the shortest time (18.33 and 18.17 days) to emerge. Sahiwal-Red required the least number of days (21) to break dormancy. Meanwhile, Kashmir exhibited the highest sprout density (4.06) and longest sprout length (8.05) compared to other varieties, showing a strong response to light conditions. In comparison, Ravi took a long time (29 days) to emerge, with the least sprout density (0.63) and a short sprouting length (2.17 cm).

Visualizing the behavior of the 15 potato varieties related to sprouting density aligns with a previous study, which observed a significant interaction between sprouting density and light exposure for up to three weeks. Sprouting density fluctuated significantly over three weeks. But by the fourth week, the effect of light on sprouting density had decreased, and the behavior began to fluctuate, which indicates that there would be no more significant effects (Gachango et al., 2008).

Temperature (3°C)

The results in Table 7 reveal the significant effect of temperature among all the varieties when exposed to ambient conditions after keeping potato tubers at 3°C for 2 weeks. Rubi and Sahiwal-White took 11.55 and 11.17 days for emergence, respectively. Rubi required the least number of days (15.2) to break dormancy. Whereas Kashmir showed the highest sprout density (6.33) and sprout length (7.63 cm) as compared to other varieties. The current study coincides with the previous investigations. Temperature regulates tubers' physiological and biochemical processes during dormancy, significantly impacting potato dormancy's development and progression. At low temperatures, the duration of dormancy can be extended; however, the total duration is shortened once the tubers are exposed to ambient conditions (Sonnewald and Sonnewald, 2014).

Table 5. Effect of darkness on potato tubers of 15 varieties.

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	18.33	20.3	5.833333	11.97
Ruby	17.87	20.17	4.62	12.43
Sadaf	19.22	25.33	3.973333	9.21
Sahiwal-White	9.13	14.05	8.746667	7.94
Sahiwal-Red	11.34	15.05	9.153333	6.28
Sialkot- Red	8.26	12.52	7.02	4.97
Cosmo	12.93	17.3	6	6.99
Satluj	16.35	19	4.55	10.33
Kashmir	15.33	19.37	3.65	8.15
Punjab	15.97	18.63	3.28	9.05
Ijaz-22	18.67	25	8.43	7.17
Ravi	13.42	15.67	5.3	13.18
Asterix	18.93	22.55	7.166667	9.07
SH	10.5	14.33	10.46667	12.33
Sante	12.4	15.3	4.683333	5.17
LSD = 0.05	5.24**	4.16**	2.589*	4.18*
CV %	15.35%	14.74%	16.97%	14.98%
Grand Mean	14.73	18.39	6.31	9.01

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***-significant at 0.1% level of significance

Table 6. Effect of light on potato tubers of 15 varieties.

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	22.37	31.53	2.18	3.63
Ruby	20	23.33	1.03	1.97
Sadaf	26	28.17	3.27	3.76
Sahiwal-White	20.67	22.33	3.37	5.28
Sahiwal-Red	18.33	21	2.47	2.42
Sialkot- Red	26.33	28.17	4.23	6.6
Cosmo	25	32.33	2	2.57
Satluj	19.67	24.67	3.12	1.83
Kashmir	18.17	25.17	4.07	8.05
Punjab	18.53	22.83	1.5	6.86
Ijaz-22	20.53	26.5	2.39	4
Ravi	29	32.17	0.63	2.17
Asterix	23.67	25.8	1.47	6.03
SH	21.33	27.6	1.47	3.43
Sante	19.83	26.2	2.42	3.02
LSD = 0.05	4.81**	4.81**	1.475**	2.37**
CV %	13.00%	10.82%	15.36%	15.65%
Grand Mean	22.19	26.65	2.38	4.05

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***- significant at 0.1% level of significance

Table 7. Effect of temperature (3°C) on potato tubers of 15 varieties

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	15.37	18.3	2.07	5.37
Ruby	11.55	15.2	3.29	5.02
Sadaf	18	24	4.43	3.76
Sahiwal-White	11.17	17.2	3.94	6.17
Sahiwal-Red	14.83	19.17	2.6	2.45
Sialkot- Red	16.83	18.17	5.3	4.68
Cosmo	10.75	13.17	3.03	1.58
Satluj	19.2	20.73	5.53	2.21
Kashmir	17.78	22.37	6.33	7.63
Punjab	15.87	18.62	2.43	7.19
Ijaz-22	15.47	18.6	2.9	4.4
Ravi	15.03	19.4	2.15	2.00
Asterix	18.03	22	1.6	6
SH	12.87	15.4	4.9	3.00
Sante	13.37	16.3	6.07	2.41
LSD (=0.05)	3.78***	2.97***	1.37***	2.26***
CV %	15.18%	9.61%	17.65%	16.9%
Grand Mean	14.95	18.53	3.78	4.2

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***- significant at 0.1% level of significance

Effect of Temperature (4-6°C)

Table 8 shows that low-temperature treatment significantly affected all varieties regarding all recorded parameters. Sahiwal-White responded most to this treatment as the least number of days (10.33) required for

emergence to break dormancy (13.88), and exhibited the longest sprout length (8.18) as compared to all other varieties. The variety Ijaz-22 had the highest sprouting density of 12.08. Current observations agree with the results of a previous research study in which tubers were

kept at a low temperature of 4-6 °C. After that, they were stored in ambient conditions, sprouting started before 1 month. Typically dormancy breaks in 2 to 3 months (Murigi et al., 2021).

Effect of Hot Water treatment

Table 9 illustrates the effect of hot water treatment on potato tubers of 15 varieties. Hot water had no notable impact on tuber dormancy or recorded data. Sante took the

least days to emerge (18.06) and break dormancy (20.86). Sahiwal-Red exhibited highest sprouting density (8.93). Satluj showed longest (5.26 cm) spouting length. The results of this study align with a previous study where potato tubers underwent hot water treatment. Following the treatment, the tubers were stored at room temperature, which led to the inhibition of sprouting. Instead of breaking dormancy, the hot water treatment was applied to extend the dormancy period (Neeraj and Dalal, 2019).

Table 8. Effect of temperature (4-6°C) on potato tubers of 15 varieties.

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	13.11	14.33	6.83	6.97
Ruby	15.87	19.63	6.25	4.15
Sadaf	16.34	17.2	5.22	5.32
Sahiwal-White	10.33	13.88	5.77	8.18
Sahiwal-Red	10.98	16.77	10.28	4.15
Sialkot- Red	15.13	16.45	7.22	7.17
Cosmo	10.7	15.72	7.02	4.66
Satluj	14.09	17.87	10.55	2.62
Kashmir	16.05	14.88	11.62	4.88
Punjab	13.33	17.55	11.22	7.05
Ijaz-22	14.1	16.54	12.08	7.27
Ravi	12.55	16.13	11.67	4.87
Asterix	15.42	19	6.3	7.21
SH	14.32	13.83	5.88	5.89
Sante	13.53	16.76	4.11	4.86
LSD (=0.05)	2.44	2.042*	1.61***	1.25**
CV %	17.01%	16.65%	13.19%	14.21%
Grand Mean	13.65	16.55	8.22	5.72

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***- significant at 0.1% level of significance, *-significant at 0.5 % level of significance

Table 9. Effect of hot water on potato tubers of 15 varieties.

Varieties	Days to Emergence (DTE)	Days to Breaking of Dormancy	Sprouting Density	Sprouting Length
PRI-Red	34	46	5.1	3.13
Ruby	40.67	42.67	4.37	3.65
Sadaf	33.67	39.93	4.9	3.23
Sahiwal-White	39	37.67	5.07	3.37
Sahiwal-Red	25.67	35	8.93	4.66
Sialkot- Red	25	30.3	6.42	4.17
Cosmo	33.67	32.56	5.27	3.6
Satluj	32.33	38.24	8.24	5.27
Kashmir	41	45.74	7.63	4.87
Punjab	45	47.67	8.53	1.97
Ijaz-22	42	46.52	6.63	3.94
Ravi	37	37.09	7.33	4.17
Asterix	26	31.08	4.2	2.8
SH	20.17	21.33	4	2.6
Sante	18.06	20.87	2.67	1.67
LSD (=0.05)	7.02	4.23	4.79	2.85

CV %	8.86	15.45	30.42	31.01
Grand Mean	32.17	35.99	5.83	3.55

CV- Coefficient of variation, LSD- Least significant difference, **- significant at 1% level of significance, ***- significant at 0.1% level of significance.

CONCLUSION

In conclusion, the effect of 09 treatments on the sprouting behavior and dormancy breaking was different for 15 potato varieties. The treatment of 3% thio-urea was seen as superior among all other treatments for recorded parameters, such as the varieties Ruby and Ijaz-22 took 6.33 & 7 days to sprout and 10.14 & 9.58 days to break dormancy, respectively, after the onset of treatment. Gibberellic acid treatment favored sprouting and reduced dormancy period in all studied varieties. Ambient circumstances, darkness, light exposure, and temperature regimes had diverse impacts on tuber sprouting behavior, highlighting genotype-specific responses. In contrast, neem-coated urea and hot water treatment had no significant effect on all recorded parameters. Although this experiment was conducted in one location and one season using 15 different varieties, including 12 locally developed varieties it is reasonable to point out that the application of 3% thiourea and Gibberellic acid combined with ambient storage of freshly harvested tubers can significantly improve the sprouting behavior and shortens dormancy period for all potato varieties. These treatments have low input costs and are readily available, so they can help to boost potato production in Pakistan. So, these treatments may be advised to farmers for tuber application and given wider publicity through Agriculture Extension Services for farmer awareness to increase the countries' potato production.

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