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Effect of Concentrations of Gibberellic Acid in Breaking Dormancy of Different Potato (Solanum tuberosum) Varieties at Rasuwa, Nepal

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Abstract

The experiment entitled "Effect of concentrations of Gibberellic acid in breaking dormancy of different potato (Solanum tuberosum) varieties at Rasuwa" was conducted in Dhunche, Rasuwa, Nepal from 2nd May to 15th June, 2017. Uniform sprouting is always a challenge to achieve. To address the problem a two factorial experiment based on completely randomized block design with four replications was conducted to investigate the effect of Five hormone treatments (H1: 0.5% of ethanol + 0 mg/l of gibberellic acid, H2:0.5% of ethanol + 5 mg/l of gibberellic acid, H3: 0.5% of ethanol + 10mg/l of gibberellic acid, H4: 0.5% of ethanol + 15mg/l of gibberellic acid, H5: 0.5% of ethanol + 20 mg/l of gibberellic acid) on mini tubers of two varieties of potato (Khumal Seto-1 and MS-42,3). The longest sprouts were about 17.34mm long and they were produced by MS-42.3 variety and in case of treatment5 the highest sprout length as 10.8125mm. The highest no of sprouts were obtained in MS-42.3 6.05 at Treatment 5 and the highest no of sprouts in Khumal seto-1 was 4.75 at treatment 5. Khumal Seto-1 had the shortest dormancy duration as well as days to first emergence at lab condition. Applying H3 hormone level produce more sprouts per tuber in Khumal Seto-1. MS-42.3 was better than Khumal Seto-1with or without hormone treatment in respect of all measured traits. Higher GA concentration accelerates tuber sprouting in both varieties. Except in dormancy break and days to first emergence all parameters observed i.e. Average Sprout Length and Average Sprout Density variety MS-42.3 was found superior in accordance to gibberellic treatment.

Keywords: Dormancy, Seed tuber, Gibberellic acid

Introduction

Potato (*Solanum tuberosum*) is one of the most important crops of Nepal. It is used as a major vegetable in terai and mid-hills and as a staple food in the high hills and mountains. Generally in the scenario of our country mainly problem in potato is dormancy and to overcome this application of gibberellic acid is must required.

Good sprouting leads to good plant establishment that leads to good production. Due to the lack of storage facility like rustic store and cold storage this directly relates to low sprouting. As in relevance to dormancy break the freshly harvested tuber are in dormant stage due to which it takes more time for sprouting and finally prolonging the growth phase of potato plant.

Among the most consumed crops and vegetable, potato ranks in top five as in level of production. To meet the increasing needs the level of production should be increased and major problem in potato cultivation is related with sprouting [1].

Application of gibberellic acid helps to solve the deletrious effect caused due to lack of good storage, low temperature and low sunlight time and finally low sprouting. Gibberellic Acid, commonly referred to as GA3, is a naturally occurring plant growth hormone that is harvested from fungus and produced commercially for the agriculture and home gardening industries.

Because of its low toxicity, the Environmental Protection Agency has approved the use of Gibberellic Acid to help hasten germination and growth in food crop. Gibberellic Acid is applied directly to growing crops which include fruits, field crops and vines. The hormone stimulates cell division and cell elongation that affect the leaves and stems in plants.

Gibberellic Acid works on germination by promoting growth in the embryo of a seed. Gibberellin is released by the embryo, where it travels to the endosperm region of the seed.

It then allows the enzyme induction of amylase, breaking down starch into a sugar for use by the embryo. There are many different recommendations as to the GA3 concentration to use: the rate often depends on the material and its stage of dormancy.

It is recommended to use solutions containing 5-10 ppm GA3 to treat all types of tubers, especially those that are old or having many cuts and bruises. A study of the effects of dormancy breaking treatments on mini-tubers of two potato cultivars revealed that the highest dormancy alleviation was obtained by 30 ppm GA3 application.

Meanwhile, 5 ppm GA3 has been noted as the appropriate amount for dormancy relief and yield improvement of 'Agria', 'Marfona' and 'Gloria' potatoes.

Similar works undertaken and indicated that GA3 is a dominant regulator in tuber formation and promotes stolon elongation, and inhibits tuber formation. reported that GA breaks sprout dormancy in potato. investigated the effect of GA and auxin on ABA and ethylene synthesis in dormant sprouts of potato.

Materials and Methods

The experiment entitled "Effect of concentrations of Gibberellic acid in breaking dormancy of different potato(Solanum tuberosum)varieties at Rasuwa" was conducted in Dhunche, Rasuwa from 2nd May to 15th June,2017 by two factorial Completely Randomized Design(CRD).

Two varieties Khumal Seto-1 and MS-42.3 was selected. The gibberellin concentration were T1-0ppm, T2-5ppm, T3-10ppm, T4-15ppm, T5-20ppm. The total treatment were as H1: (Khumal Seto-1+0ppm), H2: (Khumal Seto-1+5ppm), H3: (Khumal Seto-1+10ppm), H4: (Khumal Seto-1+15ppm), H5: (Khumal Seto-1+20ppm), H6: (MS-42.3+0ppm), H7: (MS-42.3+5ppm), H8: (MS-42.3+10ppm), H9: (MS-42.3+15ppm), H10: (MS-42.3+20ppm).

The different concentration were prepared by weighting the different amount of giberellin powder on digital weighting balance. And was mixed in water along with 0.5% ethanol. Each treatment consisted of 10 potatoes and total of 10 treatment which consisted of 5 treatment of each variety.

Each treatment had four replication. They were kept on a tray after treatment with gibberellins. After treatment, tubers were air-dried and held at 18-25 °C until sprouting occurred [2].

Results and Discussion

Average Sprout Length

Significant difference was seen in sprout length acccording the variety. It was found that the highest sprout length was given by MS-42.3(17.34) and lowest was given by Khumal seto-1(13.20) at all days after GA treatment.

Sprout length showed significant difference due to different GA treatment in 5th,10th and 15th days while it was insignificant in other days after treatment. The highest average sprout length was obtained in 20 GA treatment (10.8125) and minimum average sprout length was obtained in no GA treatment (7.8425).

Variety	Days after GA treatment							
	5th DAT	10th DAT	15th DAT	20th DAT	25th DAT	30th DAT	35th DAT	40th DAT
MS-42.3	6.89a	9.46a	11.59a	13.22a	13.96a	15.67a	16.59a	17.34a
Khumal seto-1	5.60b	6.37b	7.30b	8.56b	9.66b	10.93b	11.92b	13.20b
LSD	0.63***	0.82***	1.00***	1.18***	1.23***	1.36***	1.38***	1.44***
SEM	0.98	1.64	2.47	3.4	3.72	4.56	4.66	5.08
CV %	15.86	16.2	16.63	16.93	16.32	16.06	15.14	14.76
Grand Mean	6.25	7.91	9.44	10.89	11.81	13.3	14.25	15.27
Conc. of GA								
0ppm	4.99c	6.55b	7.84b	9.29	10.19	11.43	12.25	13.06
5ppm	5.91bc	7.49ab	9.21ab	10.77	11.6	13.05	14.02	14.95
10ppm	6.52ab	8.06ab	9.45ab	10.88	11.66	13.26	14.22	15.27
15ppm	6.63ab	8.41ab	9.92ab	11.36	12.4	14.12	15.07	16.35
20ppm	7.18a	9.06a	10.81a	12.13	13.21	14.62	15.71	16.71
LSD	0.96***	1.94***	2.65***	na	na	na	na	na
SEM	0.42	3.67	6.85	8.89	8.17	10	9.7	8.53
CV%	15.26	24.22	27.71	27.38	24.2	23.78	21.85	19.13
Grand Mean	6.25	7.91	9.44	10.89	11.81	13.3	14.25	15.27

Table1: Effect of different variety of potato on Sprout Length in Rasuwa district May, 2017.

Average Sprout Density

In case of sprout density significant difference was seen due to variety. The highest no of sprouts were obtained in MS-42.3 (6.85) at 40th DAT and lowest no of sprouts were obtained in Khumal Seto-1 (5.30) at 40th DAT Table 2.

Variety	Days after GA treatment							
	5th DAT	**10th DAT**	**15th DAT**	**20th DAT**	**25th DAT**	**30th DAT**	**35th DAT**	**40th DAT**
MS-42.3	5.29a	5.93a	6.39a	6.52a	6.54a	6.69a	6.75a	6.85a
Khumal seto-1	3.80b	4.25b	4.60b	4.85b	5.05b	5.25b	5.30b	5.30b
LSD	0.55***	0.46***	0.45***	0.46***	0.44***	0.41***	0.42***	0.42***
SEM	0.74	0.52	0.5	0.52	0.47	0.42	0.44	0.43
CV %	18.98	14.25	12.89	12.74	11.92	10.9	11.07	10.82
Grand Mean	4.54	5.09	5.49	5.68	5.79	5.97	6.02	6.07
Conc. of GA								
0ppm	2.10b	2.70b	3.80b	4.55 b	5.52 b	5.77 b	6.05 b	6.35 b
5ppm	4.40ab	4.87ab	5.75ab	6.40 ab	6.65ab	6.82ab	7.15ab	7.45 ab
10ppm	6.50a	6.95a	7.37a	7.87 a	7.98 a	8.05 a	8.30 a	8.65 a
15ppm	4.77ab	5.25ab	5.85ab	6.20ab	6.66 ab	6.81ab	6.97ab	7.40 ab
20ppm	4.95ab	5.40ab	6.02 ab	6.10ab	6.32 ab	6.48ab	6.87ab	7.48ab
LSD	1.17*	1.15*	1.18*	1.39*	1.04*	1.00*	1.04*	1.07*
SEM	1.34	1.3	1.37	1.25	1.05	0.97	1.05	1.11
CV%	25.53	22.4	21.32	19.74	17.71	16.56	17.01	17.38
Grand Mean	4.54	5.09	5.49	5.68	5.79	5.97	6.02	6.07

Table2: Effect of potato variety on sprout density in Rasuwa district, May, 2017.

In case of effect of different treatment of gibberellic acid on sprout density, the maximum number of sprouts was obtained by 10ppm GA treatment and minimum number of sprouts was obtained in 0ppm at all days after treatment. The maximum no of sprouts was 8.65 obtained in treatment3 and minimum no of sprouts was 6.35 obtained in treatment1 at 40DAT [3].

Days to First Emergence and Dormancy break

Significant difference was seen in days to first emergence and dormancy break due to variety. The first sprout was seen in MS-42.3 at 4.065 days while in khumal seto -1 first sprout was seen in 2.465 days. The days to dormancy break in MS-42.3 was 7.235 days while in khumal seto-1 it was 5.155 days.

	Days to first emergence	Dormancy break
Variety		
MS-42.3	4.06a	7.23a
Khumal seto-1	2.46b	5.15b
LSD	0.25***	0.47***
SEM	0.15	0.54
CV %	12.22	11.89
Grand Mean	3.26	6.19
Concentration of GA		
0ppm	5.71b	7.20 a
5ppm	4.03 ab	6.55ab
10ppm	3.77 ab	6.25ab

15ppm	3.72ab	5.66b
20ppm	2.76 a	5.31b
LSD	0.89*	1.16*
SEM	0.77	1.32
CV%	26.95	18.56
Grand Mean	3.26	6.19

Table3: Effect of potato variety on days to first emergence and dormancy break in Rasuwa district, 2017.

In case of GA treatment the minimum first day of emergence was seen in treatment 20ppm i.e.2.762 and maximum first day of emergence was seen in treatment 10ppm. The minimum days to dormancy break was 7.2 at treatment (0ppm) and maximum days to dormancy break was 5.312 at treatment5 (20ppm) at par with treatment4 (15ppm) i.e.5.6625.

Discussion

The high response of MS-42.3 on sprout length and density may be due to genetic variations. The activity of hydrolase enzyme may be high due to which conversion of starch to sugar is more resulting in high no and length of sprouting. Many of these differences among species have been associated with adaptation to the environment of their origin. High GA levels might keep the transversal cortical microtubular cytoskeleton stable so that cells in the sub-apical region divide transversally, and cell elongation will hence result in sprout elongation [4]. GA is responsible for cell elongation and may play a role in stimulating cell division in meristimic areas. Stated that application of GA alone or in combination with thiourea broke dormancy and increased the number and the length of sprout. GA3 application as liquid solutions accelerates eye growth via sprout emergence and produces more slim accessory shoots. GA is responsible for the shortening of the rest period of freshly harvested potatoes, hastening the sprouting and emergence. GA may terminate dormancy by activating the synthesis of DNA and RNA [5].

Conclusion

The longest sprouts were about 17.34mm long and they were produced by MS-42.3 variety and in case of treatment5 the highest sprout length as 10.8125mm. The highest no of sprouts were obtained in MS-42.3 6.05 by 20 ppm GA and the highest no of sprouts in khumal seto-1 was 4.75 by 20 ppm GA treatment. Khumal Seto-1 had the shortest dormancy duration as well as days to first emergence at lab condition. Higher GA concentration accelerates tuber sprouting in both varieties. The varietal response on sprouting may be due to the different genetic variation. It may be also due to high conversion of starch into sugar which result in high sprouting and sprout length.

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