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Effect of tuber treatment with plant extracts as inducer on tuber germination, growth and yield of potato

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Abstract
Eleven plant extrects inducers like *Parthenium hysterophorus, Lantana camara, Physalis, Melilotus albus, Datura metel (alba), Solanum nigrum, Achyranthes aspera, Salix alba, Thevetia peruviana* (yellow kaner), *Duranta erecta* and *Polyalthia longifolia* have been used as seed tuber treatment to find out their effect on germination, growth parameter and yield of potato in pot culture. Tuber treated with plant extracts stimulated the germination of potato tuber. Among the entire treatments three plant extracts namely *Parthenium hysterophorus, Lantana camara* and *Physalis* treated tuber have given 100% germination over control. The growth promoting effect of among the plant extracts was perceived with *Lantana camara* treatment showing maximum shoot length, representing maximum 19.8% shoot length at 30 days after sowing of potato tuber over control. The maximum number of large size tuber were harvested in *L. camara* treated plant representing 3 tuber, with total weight of 378.42 gm followed by *P. hysterophorus*, which is 2 tuber, having total weight of 354.0 gm among all the treatments over control. As per yield concerned the highest total yield 378.42 gm per plant/pot was recorded from *L. camara* followed by *P. hysterophorus* was showing 354.0 gm/plant/pot representing, second highest among the treatment over control. Lowest yield was recorded *Polyalthia longifolia* treated plant representing only 190.0 gm/plant/pot. The other treatments were also showed significant effect in increasing growth and yield parameters potato plants compared to control.

Keywords: potato, early blight, *Alternaria solani,* Plant extracts, Inducer, *Polyalthia longifolia*

Introduction
Potato (*Solanum tuberosum* L.) is popularly known as the 'King of vegetables' and a native of South America. It is a most important food crops in over the world. It is used as vegetable, stock feed and in industries for manufacturing starch, alcoholic beverages and other processed products. Potato is also gained a considerable importance as an export crop to European markets and other parts of the world is one of the important sources for national income. (El-Sirafy *et al.*, 2008; El-Mougy, 2009) [9, 10]. The major countries to which India exports potato are Nepal (32.1%), Sri Lanka (30.4%), Russia (18.6%), Malaysia (5.8%) and Mauritius (4.9%). It has now become an indispensable part of Indian cuisine. Potato is the world's fourth important food crop after wheat, rice and maize because of its higher yield potential and high nutritive value. Potato occupied 19.24 million hectares of land in the world with a production of 374.38 million tons during 2013-14. The top five potato producing country in the world are China (74.8 mMT), India (41.565 mMT), Russia (21.1 mMT), Ukraine (18.7 mMT) and US (18.3 mMT). India produced 41.565 million metric tonne (mMT) of potato from an area of 18.87 lakh hectares of land during (2011-12) Gracy *et al.,* (2013) [2]. The leading potato producing states in India are Uttar Pradesh (32%) followed by West Bengal (30%), Bihar (14%), Punjab (5%) and Gujarat (4%) which constitute about 85% of the total domestic potato production (Gracy *et al.,* 2013) [12]. The production and productivity of potato in India are quite impressive. However, in the background of increasing population there is a need for production from same piece of land. The various factors limiting yield of potato include lack of HYV, inadequate supply of healthy seed tubers and high incidence of diseases and pests. Therefore, there is a need to overcome all the limiting factors by development of new of innovative approaches for increase production and productivity of crop. Use of plant product in the field of crop production and protection is not only important but also economical and

ecofriendly. (Source: National Horticulture database, 2015). Potato production in Uttar Pradesh has caught the attention of many prospective food processing entrepreneurs, and even the Netherlands ambassador Alphonsus Stoelinga, during his recent visit to Lucknow, had said that his country was looking for setting up potato processing centre in Uttar Pradesh (The Times of India Feb.19, 2013).

Keeping all the point on views the study was undertaken the present investigation as "Effect of tuber treatment with plant extracts as inducer on tuber germination, growth and yield of potato".

Material and Method

Seed tuber treatment with plant extracts as inducers

Truly labeled potato seed tubers of variety '*Kufri Sindhuri*' were collected from Vegetable Research Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur to conduct the experiment. Two seed tubers were placed in each jar containing require concentration of solution of each inducer for five hours. It was then removes from the jar and shaded dry and used for sowing in pots.

Germination test

Seed tuber treated with different plant extracts was responsible for early breaking of seed tuber dormancy thereby increasing the germination percentage of seed tuber. The treated tubers seeds were planted in 30 cm pots which were previously filled up with a mixture of sterilized sandy loam soil and FYM in the ratio of 2:1. Two treated tubers were placed in each pot and watered as per need based. Three replications were kept for each treatment. In one experiment, untreated tubers were sown served as control. The observation on germination of tuber was taken at every 24 hours up to 10 days. Germination percentage was calculated by use of following formula:

Germination % = Number of germinated seed tubers / Number of total seeds ×100

Growth parameters

The experiment was conducted at the Wire house complex, Department of Plant Pathology, C.S.A. University of Agriculture and Technology, Kanpur. The seed tubers of potato variety '*Kufri Sindhuri*' were treated with plant extracts inducer separately and sown in 30cm earthen pots, which were previously filled with a mixture of sterilized sandy loam and farm yard manure in the ratio of 2:1. In each pot one seed tubers were sown and watered as per needed. Four replications per treatment and four pots were sown with untreated seed tubers served as control. Observations pertaining to effect of different treatments on the growth of plant (Shoot) were observed every 5 days interval from date of sowing up to 30 days age of plants.

Results and Discussion

Effect of plant extracts inducer on seed tuber germination and plant height of potato

Tuber treated with plant extracts as inducer stimulated the germination of potato tuber. Among the treatments, four plant extracts namely *Parthenium hysterophorus, Lantana camara Physalis* and *Solanum nigrum* have given 100% germination against 70% in case of control. The other treatments like *Melilotus albus* and *Salix sp.* showed 70% and *Datura stramonium*, *Achyranthus aspera*, *Thevetia peruviana*, *Durenta erecta* and *Polyanthia longifolia* showed 80% tuber germination. From the table-1, it is cleared that the entire plant extracts treated tuber significantly increased seed tuber germination of potato.

Some plant extracts are an endogenous growth regulator of phenolic nature, which influence a range of diverse processes in plants, including seed germination (Abdel-Monaim 2010; Gharib and Hegazi, 2010) [3, 11], ion uptake and transport, membrane permeability (Barkosky and Eiinihellig, 1993), photosynthetic and growth rate (Khan, *et al.*, 2003) [15], El-Mohamedy (2014) [8].

Plant height

The effects of seed treatment with various plant extracts as inducers on plant height of potato were studied under Wire House Complex in pot culture experiment. The observations of plant height were taken at 10days, 15 days, 20 days, 25 days and 30 days after sowing. The data presented in Table-1 shows that the plant height of potato was increase in all the treatments over control. The maximum plant height was found in *Lantana camara* treated seed tubers, representing the value 4.9, 6.9, 8.6, 10.4 and 19.8 cm at 10, 15, 20, 25 and 30 days age of seedling, respectively against 2.9, 5.0, 6.9, 8.1 and 10.2 in case of control. The *Parthenium hysterophorus* treated plant showing 1.75 4.0,7.9,15.3 and 18.0 cm at 10, 15, 20, 25 and 30 days age of plant respectively, representing second highest among the treatment. Among the treatments, the minimum plant height was recorded in case of *Polyanthia longifolia* treated plant. From the table, it is cleared that all plant extracts treated plant were statistically significant in respect to plant height at 10, 15, 20, 25 and 30 days age of plant. *Lantana camara* perform important actions in growth and development processes of plants. The positive effects of organic manure on the plant height, shoot dry matter and LAI have been previously reported by several workers (Abou-Hussein *et al*., 2003) [4]. Organic manure cattle and/or chicken influencing the absorption of nutrient elements by its effects on vegetative plant growth, and subsequently the total crop yield and its nutritional values. These results are in agreement with that obtained by several workers Sincike *et al*., 2008; Abou-Hussein *et al*., 2003 [4], Al-Moshileh and Motwei, 2005**.**

Table 1: Effect of plant extracts as inducer on germination and growth parameters of potato at different days of interval (Wire house condition)

Name of inducer	Germination (%)	Effect of inducers on plant height of potato (cm) (Mean value of two years data)					% Increase of plant height over control at 30 Days
		10 DAS	15 DAS	20 DAS	25 DAS	30 DAS	
Parthenium hysterophorus	100.00	1.75	4.0	7.9	15.3	18.0	43.34
Lantana camara	100.00	4.9	6.9	8.9	10.4	19.8	48.48
Physalis	100.00	1.7	1.9	3.4	8.9	16.3	37.42
Melilotus albus	70.00	2.15	3.9	6.2	8.2	12.3	17.07
Datura stramonium	80.00	2.9	5.0	6.1	9.3	15.0	32.00
Solanum nigrum	100.00	1.9	3.5	4.9	8.9	15.5	34.19
Achyranthus aspera	80.00	1.98	3.2	4.5	11.5	13.6	25.00

Salix sp.	70.00	1.2	2.1	5.3	6.3	12.9	20.93
Thevetia peruviana	80.00	1.75	3.0	4.6	10.3	14.2	28.16
Durenta erecta	80.00	2.6	4.9	8.5	11.3	14.8	31.08
Polyanthia longifolia	80.00	1.34	3.12	7.12	14.9	16.00	36.34
Control	70.00	2.9	5.0	6.9	8.1	10.2	0
C.D.P=(0.05)		0.173	0.251	0.392	0.648	0.922	
S.E (m)		0.059	0.085	0.133	0.221	0.314	
S.E (d)		0.083	0.121	0.189	0.312	0.418	
C.V.		4.201	3.817	3.731	3.716	3.654	

Effect of plant extracts on tuber size and yield of potato

The effect of tubers treatment and foliar spray with plant extracts as inducers on tuber size and yield was studied after harvesting. Tubers were graded as large (more than 50 gm), medium (25 gm – 49.5 gm) and small (less than 25 gm) in size. The data represented in Table 2 showed that maximum number of large size tuber were harvested in *Lantana camara* treated plant representing 3 tuber with total weight of 378.0 gm/plant followed by *Parthenium hysterophorus*, which is 1 tuber, having total weight of 51.00 gm/plant. The maximum number of medium size tuber was obtained in *Parthenium hysterophorus* and *Lantana camara* treated plant, representing the 2 tuber for each treatments with the total weight of 135.90 and 90.32 gm/plant respectively and regarding small size, maximum number tuber were found in *Polyanthia longifolia* followed by *Thevetia peruviana* representing the 50 and 37 tubers, respectively. From the table-2 also cleared that the plant treated with *Melilotus albus*, *Salix* sp., *Thevetia peruviana*, *Polyanthia longifolia* and control plants are not produced any large size tubers.

As per yield is concerned, the highest total yield 378.42 gm/plant/pot was recorded from *Lantana camara* treated plant. The *Parthenium hysterophorus* treated plant was showing 354.00 gm/plant/pot representing, second highest among the treatment, which was followed by *Physalis*, *Polyalthia longifolia*, *Datura metel* (Alba), *Solanum nigrum*, *Achyranthes aspera*, *Salix alba*, *Thevetia peruviana* (yellow kaner), and *Duranta erecta*, representing total yield 326.0, 190.0, 231.10, 311.0, 232.30, 192.0, 251.0, 170.10 gm/plant/pot, respectively. Among the treatment lowest yield was recorded *Melilotus albus*, treated plant representing 170.0 gm/plant/pot. From the table, it is cleared that all the plant extracts were statistically significant in respect of potato yield. Abd-El-Kareem (1998) [1] stated that spraying cucumber plants with K_2HPO_4 (100mM) provided induced resistance against downy and powdery mildews and increased fruit yield per plant under commercial greenhouse conditions. Abd-El-Kareem *et al.* (2001) [2] also reported that, treated potato plants with chitosan provided induced resistance against late and early blight diseases and increased tuber yield under field conditions.

Table 2: Effect of plant extractsas inducers on tuber size and yield of potato (wire house condition)

Name of inducer	Large (>50gm)		Medium (25-49.5gm)		Small (<25gm)		Total Yield (gm/plant/pot)	% Increase Yield Over Control
	Total Number of Tuber	Weight	Total Number of Tuber	Weight	Total Number of Tuber	Weight		
Parthenium hysterophorus	1	51.00	5	135.90	20	167.10	354.00	53.31
Lantana camara	3	152.00	4	90.32	25	136.10	378.42	56.32
Physalis	1	53.00	1	26.00	37	247.00	326.00	49.30
Melilotus albus	0	0.00	0	0.00	18	170.00	170.00	2.77
Datura stramonium	1	56.00	1	25.10	17	150.00	231.10	28.48
Solanum nigrum	1	55.00	2	60.00	21	196.00	311.00	46.85
Achyranthus aspera	1	51.10	2	62.20	15	120.00	232.30	28.85
Salix sp.	0	0.00	2	62.00	16	130.0	192.0	13.91
Thevetia peruviana	0	0.00	0	0.0	35	251.00	251.0	34.15
Durenta erecta	1	53.00	1	26.10	16	170.10	249.20	33.67
Polyanthia longifolia	0	0.00	0	0.00	50	190.0	190.0	13.01
Control	0	0.00	0	0.00	21	165.28	165.28	0
C.D.P=(0.05)	0.043	2.293	0.137	3.658	1.588	12.065	16.043	
S.E (m)	0.015	0.781	0.047	1.246	0.541	4.109	5.464	
S.E (d)	0.021	1.104	0.066	1.762	0.765	5.811	7.727	
C.V.	5.099	5.102	4.837	4.770	3.959	3.778	3.748	

Conclusion

From this study it can be concluded that plant extracts can play an important role in enhancing the germination of seed potato tuber, increase vegetative growth as well as yield of potato. Therefore, application these plant extracts practically use for further investigation.

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