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Pre-sowing seed treatments with different chemicals and growth regulator on seed germination and growth of passion fruit

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ABSTRACT : Passion fruit is getting popularity and its cultivation is gradually increasing in India. Very few works had been carried out regarding cultivation of this fruit. For large production and easy procurement of planting material, propagation from seeds may be done. Hence, there is need to improve germinations and vigour of seedlings. Keeping the above points in view, the present investigation was carried out. In this experiment, pre-sowing seed treatments were done with different chemicals (50%HCl. 5%H_2SO_4, 1% thiourea, 1% KNO_3, 2% sucrose, 2% urea, 2% bleaching powder) and growth regulator (100ppm GA_3) on seed germination of passion fruit. The objective of this experiment was to standardize the effect of pre-sowing seed treatment which consisted of 9 treatments and one control. The experiment was laid out during 2009-10 and 2010-11 in experimental polyhouse in the Department of Horticulture, Birsa Agricultural University, Kanke, Ranchi (Jharkhand) and was conducted in the statistical design, CRD. All the treatments exhibited better results over untreated control, but (S_8) seeds treated with 2 per cent bleaching powder in 24 hrs treatment emerged as the best regarding germination, growth of the seedlings followed by (S_5) seeds treated with 100ppm GA_3 for 30 min.

KEY **W**ORDS : Pre-sowing, Seed treatments, Chemicals, Growth regulator, Germination, Growth, passion fruit

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India achieved self sufficiency in food grains but mere achievement of self-sufficiency in food grains production is not enough, without ensuring nutrition and balance diet to every citizen, which is the highest priority of a planned development. Fruit, being a rich source of carbohydrate, protein, minerals, vitamins, etc., are considered very much essential for proper growth and protection of human body from different diseases and disorders.

India is bestowed with a wide range of soil and agro-climatic conditions. Therefore, almost all types of fruit can be grown in one or the other parts of the country such as mango, guava, litchi, banana, citrus, papaya, apple, pear, plum etc. In which the passion fruit is one of the unique fruit. The passion fruit is a high value and export oriented crop. It belongs to the family Passifloracea, which is represented by 14 genera. The genus *Passiflora* is the principal representative of the family and comprises of nearly 580 species, distributed throughout the tropical and subtropical regions of the world (Silva and San, 1994). More than 150 species are native to Brazil, out of which 60 bear edible fruit but only a few are of commercial importance.

It occupies an important place among the fruits

grown in India. North Eastern parts of India have greater potential for establishing passion fruit globe on commercial scale. Recently, this fruit has come into prominence among the people of north eastern states of India particularly in Meghalaya, Manipur, Mizoram, Nagaland and Sikkim due to its pleasant aroma, rich flavour, prolific bearing habit and higher return even without much care.

The juice of passion fruit is acidic in nature and has an excellent flavour and is quite delicious, nutritious and liked by most people for its blending quality. Passion fruits are good source of vitamin-A, ascorbic acid, riboflavin and niacin and also contain fair amount of minerals sodium, magnesium, sulphur and chlorides. It is extensively used in confectionary and in preparation of cakes, pies, sherbet, ice cream and fruit nectar.

The passion juice and leaves are used in many countries as medicines. The flower of passion fruit has a mild sedative effect and can help to induce sleep. Passion flower has been used in the treatment of nervous disorder, bronchial asthma, insomnia and nervous disorders. Researchers at the University of Florida have found that yellow passion fruit extracts can kill cancer cells *in vitro*. The passion flower extracts is used in treating asthma, whooping cough, bronchitis and other tough coughs.

Passion fruit is getting popularity and its cultivation is gradually increasing in India. Research works had been initiated in many passion fruit growing areas. Passion fruit is not used as a desert fruit because of its being high acidic in nature, it needs to be processed before consumption. Very few researches had been carried out regarding cultivation of this fruit. Hence, availability of research reviews about cultivation and storage is also very meagre. Passion fruit is comparatively a new crop for the region. A few varieties are available in Jharkhand so there are less chances of variation. The passion fruit can be propagated from vine cutting and seeds. Vegetatively propagated clones are true to types. However, for large production and as easy procurement of planting material, propagation from seeds may be done. Hence, there is need to improve germinations and vigour of seedlings. Keeping the above points in view, the present investigation was undertaken with the objective as to see the effect of pre-sowing seed treatments of chemicals and growth regulator on germination and growth of seedlings of passion fruit.

RESEARCH PROCEDURE

During the period of investigations the observations were recorded for different characters. For observing the different vegetative characters, five plants in each treatment of all the replications were selected randomly and tagged plants of the experiment were recorded accordingly at 30, 45, 60, 75 and 90 days after sowing of seeds.

Fully ripe fruits of uniform size were selected, pulps were removed and seeds were carefully extracted. After extraction, seeds were kept in shade for 5 days for drying.

Seeds were treated separately. After treating the seeds in different solution, it was kept on paper for one hour for drying. Immediately after drying, treated and untreated (control) seeds were sown and were watered immediately after sowing of seeds.

Germination percentage were calculated out by counting of the number of emerging seedling at 30, 45, 60, 75 and 90 days of sowing seeds and the percentage was calculated.

Days taken from sowing to formation of 4 leaves in 5 randomly selected plants in each replication were noted and the average was calculated. Four lower leaves were taken in each selected plant and length breadth was measured. The average was computed in each replication. The numbers of leaves were counted at 30, 45, 60, 75 and 90 days of sowing seed of selected plant.

For measurement of height of plants, the stem was marked carefully above the soil surface with black paint which served as a permanent marker for recording height at subsequent dates of observations. Average height was calculated treatment wise in centimetre.

Five plants of 90 days after sowing were uprooted and washed. The fresh weight of five plants were measured and added. The average weight of biomass production per seedling was calculated by dividing by 5 then fresh and dry weight of shoot and root was taken separately. And average fresh and dry weight of shoot and root were calculated separately.

Treatment details :

S_1 - Seeds treated with 50% HCl for 1 hr
S_2 - Seeds treated with 5% H_2SO_4 for 3 min.
S_3 - Seeds treated with 1% thiourea for 15 min
S_4 - Seeds treated with 1% KNO_3 for 15 min
S_5- Seeds treated with 100ppm GA_3 for 30 min
S_6- Seeds treated with 2% sucrose for 2 hrs
S_7 - Seeds treated with 2% urea for 24 hrs
S_8 - Seeds treated with2% bleaching powder in 24 hrs

S_9 - Seeds soaked for 24 hrs in water.
S_{10} - Control (no soaking)
Experimental design - CRD

RESEARCH ANALYSIS AND REASONING

The data on seed germination percentage of passion fruit after 30, 60, 90 and 120 days of sowing have been presented in the Table 1. In pooled data analysis of both the year 2009-10 and 2010-11, maximum seed germination percentage was found in S_8 (30.81%) with seed treated with 2 per cent bleaching powder for 24 hrs but in S_{10} (control) has no germination was observed. After 60 days of sowing, maximum germination was obtained in S_8 (72.67%) followed by S_5 (43.75%) *i.e.* seeds treated with 100ppm GA_3 for 30 minutes whereas minimum germination was recorded in control (10.48%). Seed germination after 90 days of sowing have also shown the similar trend. Maximum value (99.24%) was recorded in seed treated with 2% bleaching powder for 24 hrs and minimum value (26.59%) was observed in control. Whereas after 120 days of sowing, in this data, S_8 (99.74%) showed the superiority among all the treatments followed by S_5 (98.22%). Minimum value (48.50%) was observed in control. All the treatments significantly increased germination percentage compared to control in both the years.

Data on effect of different pre-sowing treatments on time taken for 4 leaves initiation and size of lower four leaves have been also presented in Table 1.

The data indicated minimum days taken for 4 leaves initiation (75.05 days) when seed treated with 2 per cent of bleaching powder for 24 hrs (S_8) followed by seed treated with 100 ppm GA_3 for 30 min. Maximum value (137.47 days) was recorded in case of control. All the treatments have significantly taken less time for four leaves initiation compared to control.

The data regarding size of lower four leaves have indicated maximum leaf area (10.99 cm^2) was in case of S_8 (seed treated with 2% bleaching powder). The minimum value (1.38 cm^2) was recorded in case of control (S_{10}). All the treatments have significantly increased germination percentage compared to control in both the years.

The data regarding number of leaves after germination have been presented in Table 2. At 30, 45, 60, 75, 90, 105 and 120 days after sowing, the maximum leaf number showed in case of seed treated with 2 per cent bleaching powder for 24 hrs as 2.14, 2.97, 3.87, 4.62, 5.20, 5.85 and 6.42, respectively whereas the minimum value was recorded in case of control (S_{10}). The rest other treatments also significantly increased number of leaves in comparison to control.

Data on plant height at different days after sowing (DAS) and biomass production of passion fruit are given in Table 3. Maximum plant height after 30 days was recorded in case of S_8 when seed treated with 2 per cent bleaching powder for 24 hrs which was at par with S_5

Table 1 : Effect of pre-sowing seed treatments with different chemicals and growth regulators on seed germination, time taken for 4 leaves and size of lower four leaves on passion fruit

Treatments	Seed germination				Time taken for 4 leaves	Size of lower four leaves
	After 30 days	After 60 days	After 90 days	After 120 days		
S_1 (HCl)	12.02(21.28)	34.60 (36.40)	53.22 (41.82)	84.59 (67.28)	115.79	3.47
S_2 (H_2SO_4)	13.47 (22.76)	39.40 (38.98)	68.14 (55.06)	88.69 (70.90)	103.80	6.31
S_3 (Thiourea)	14.59 (22.99)	36.49 (37.70)	65.30 (54.42)	91.35 (73.23)	101.52	4.92
S_4 (KNO_3)	16.79 (24.64)	40.63 (39.83)	80.90 (64.61)	95.37 (78.14)	88.70	3.83
S_5 (GA_3)	18.51 (26.03)	43.75 (41.88)	85.42 (68.20)	98.22 (40.98)	81.88	9.79
S_6 (Sucrose)	10.73 (19.19)	31.14 (34.42)	58.59 (50.12)	75.47 (60.75)	97.20	3.22
S_7 (Urea)	13.22 (23.24)	32.39 (35.16)	61.85 (52.40)	79.02 (63.07)	85.04	5.61
S_8 (Bleaching powder)	30.81 (34.18)	72.67 (58.85)	99.24 (84.75)	99.74 (88.13)	75.05	10.99
S_9 (Water)	3.90 (4.21)	28.69 (32.85)	55.09 (48.42)	71.32 (57.60)	123.32	1.77
S_{10} (Control)	0.00 (0.00)	10.48 (19.05)	26.59 (31.29)	48.50 (43.66)	137.47	1.38
S.E.±	(0.71)	(0.47)	(3.10)	(8.46)	2.99	0.20
C.D. (P=0.05)	(2.28)	(1.50)	(9.88)	(NS)	9.57	0.64
CV %	(5.09)	(1.77)	(6.69)	(0.38)	4.20	5.44

NS= Non-significant

(1.94 cm) and S_4 (1.82 cm) but significantly superior to rest other treatments. There was no germination in control after 30 DAS. The plant height at 45, 60, 75, 90, 105 and 120 days after sowing, indicated the maximum plant height as 2.74, 4.59, 5.80, 7.23, 7.53 and 8.32 cm, respectively with seed treated with 2 per cent bleaching powder for 24 hrs. Whereas the minimum values 0.67, 1.25, 1.63, 2.52, 2.82 and 3.57 cm, respectively were recorded in case of control (S_{10}). All the treatments showed better performance compared to control.

Data on effect of different pre-sowing treatments on dry biomass production on root and shoot weight was significant during both the years. Pooled analysis of data indicated that the maximum biomass (2.52 g) was recorded in seed treated with 2 per cent bleaching powder from 24 hrs (S_8) which was superior to all the treatments. The minimum biomass weight (0.93 g) was recorded in case of S_{10} (control). All the treatments showed better performance compared to control.

The maximum germination percentage, minimum time taken for 4 leaves, size of lower four leaves, maximum number of leaves, maximum plant height and maximum

Table 2 : Effect of pre-sowing seed treatments with different chemicals and growth regulators on number of leaves after germination on passion fruit

Treatments	No. of leaves						
	After 30 days	After 45 days	After 60 days	After 75 days	After 90 days	After 105 days	After 120 days
S_1 (HCl)	0.45	1.02	1.47	2.38	3.19	3.78	4.10
S_2 (H_2SO_4)	1.17	2.04	2.37	2.92	3.60	4.18	4.50
S_3 (Thiourea)	1.47	2.22	2.74	3.44	3.74	4.57	4.75
S_4 (KNO_3)	1.82	2.40	2.84	3.72	4.27	4.87	5.22
S_5 (GA_3)	1.92	2.50	3.10	3.90	3.92	4.99	5.59
S_6 (Sucrose)	1.13	1.82	2.73	3.40	3.68	4.57	4.92
S_7 (Urea)	1.54	2.12	2.55	3.14	3.49	4.78	5.12
S_8 (Bleaching powder)	2.14	2.97	3.87	4.62	5.20	5.85	6.42
S_9 (Water)	0.73	1.30	2.07	2.37	2.93	3.60	3.86
S_{10} (Control)	0.00	0.64	1.47	1.82	2.37	2.79	3.12
S.E.±	0.06	0.09	0.07	0.04	0.05	0.05	0.05
C.D. (P=0.05)	0.17	0.13	0.20	0.12	0.15	0.17	0.16
CV %	6.25	2.95	3.58	1.63	1.81	1.73	1.48

Table 3 : Effect of pre-sowing seed treatments with different chemicals and growth regulators on plant height and biomass production of passion fruit

Treatments	Plant height after days of germination							Biomass production
	after 30 days	after 45 days	after 60 days	after 75 days	after 90 days	after 105 days	after 120 days	
S_1 (HCl)	0.94	2.24	2.61	3.25	4.25	4.66	5.27	1.10
S_2 (H_2SO_4)	1.47	2.40	3.32	4.39	5.87	6.27	6.80	1.34
S_3 (Thiourea)	1.52	2.15	2.67	3.44	4.79	5.05	5.59	1.51
S_4 (KNO_3)	1.82	2.20	2.70	3.55	5.20	5.47	6.02	1.75
S_5 (GA_3)	1.94	2.51	3.45	4.13	5.38	5.58	6.39	1.88
S_6 (Sucrose)	1.13	1.62	2.22	2.80	3.80	4.05	4.53	1.23
S_7 (Urea)	1.39	2.10	3.05	3.47	5.17	5.49	5.64	1.55
S_8 (Bleaching powder)	2.09	2.74	4.59	5.80	7.23	7.53	8.32	2.52
S_9 (Water)	0.73	1.35	1.74	1.94	3.28	3.52	4.22	1.19
S_{10} (Control)	0.00	0.67	1.25	1.63	2.52	2.82	3.57	0.93
S.E.±	0.18	0.16	0.08	0.13	0.28	0.11	0.08	0.17
C.D. (P=0.05)	0.57	0.49	0.27	0.40	0.90	0.35	0.26	0.47
CV %	3.50	11.08	4.26	5.19	8.42	3.04	2.02	2.23

biomass were observed in S_8 (seed treated with bleaching power) followed by seed treated with GA_3. The other treatments like HCl, H_2SO_4, thiourea, KNO_3, GA_3, sucrose, urea and water had also favourable effects on seed germination and growth compared to control.

Bleaching powder is a mixture of calcium hypochlorite Ca (ClO_2) and the basic chloride $CaCl_2$, Ca (OH_2) with some slaked lime, calcium hypochlorite reacts with carbon dioxide to form calcium carbonate and release chlorine. It also reacts with hypochloric acid to form calcium chloride. Calcium is a constituent of the cell wall as such it increases stiffness of straw, promotes early root development and growth. It provides a base for neutralization of organic acids commonly termed as poison produced in the plant, calcium activates growing points, especially root tips, influences the water economy of the plants, affect the proteins, carbohydrate ratio, activates fat metabolism as well as many other physiological processes. It improves intake of other plant nutrients especially nitrogen and trace element such as iron, boron, zinc, copper and manganese by correcting soil pH (Yawalker *et al*., 1992).

Calcium, a constituent of bleaching powder, might have played above roles resulting in better germination and growth.

Bleaching powder is also known to undergo self heating causing softening of seed coats. Besides, this chemical also acts as an insecticide by killing nematodes and other harmful insects of soil. Softening of seed coat resulted in quick germination and thereby healthy seedlings. Consequently, seedlings because of good health maintained their superiority regarding better growth, higher success and enhanced survival percentage.

The present finding is also in conformity with the finding of De *et al*. (1998), who obtained increased germination percentage and better root and shoot length of black gram seeds when treated with bleaching powder. Germination percentage of rice seeds was significantly improved due to bleaching powder treatment (Pal and Basu, 1994).

Gibberellins are weak acidic growth hormones having gibbane ring structure which cause cell elongation of intact plant in general and increase internodal length of genetically dwarf plant in particular. It is synthesized in the apical shoot bud (young leaves), root tip and developing the precursor for their synthesis in movolonic acid. Gibberellins transport occurs through simple diffusion as well as through conducting channels.

During seed germination, especially of cereals, gibberellins stimulate the production of some messenger RNA and then hydrolytic enzyme like amylases. The enzyme solubelises the reserve food of the seed. Gibberellins overcome the natural dormancy of buds, tuber, seed etc and allow them to grow. In this function, they are antagonistic to abscesic acid. Gibberellins help in cell growth of stem, leaves and other several part. Therefore, they increase the size of stems, leaves, flower and fruits. Due to these functions of gibberellins, favourable effects obtained in the present investigation are quite reasonable.

Brain and Hemming (1955) reported that the effect of gibberllins on the growth of genetically dwarfed plants such as dwarfed varieties of corn, peas or beans was due to cell division in the sub-division in the sub apical meristem and cell expansion. Brain *et al*. (1962) observed that gibberellins require the presence of an active or potentially active meristematic area for full expression of growth promoting effect. Paleg (1965) concluded that the mechanism of gibberellin action in the apexs of responsive plants results in increased protein synthesis, cell division, auxin production and cell expansion. Bhambota and Kaul (1966) reported that GA_3 appreciably increased and dimension of individual cell both in cortex and pith regions but did not accelerate cell division.

Many fleshy harvested dormant seeds germinate better after soaking in potassium nitrate solution. The technique is used largely in seed-testing laboratories. The seeds are moistened with 1 per cent KNO_3 for 15 min potassium nitrate is widely used chemical or promoting seed germination in different species (Singh *et al*., 1989).

The significant increase in the seedling growth was obtained when treated with HCl. HCl acid must be used with care because it is strongly corrosive and reacts violently with water, causing high temperatures and splattering. The procedure is useful in modifying hard or impermeable seed covering. Soaking seeds in 50 per cent HCl for one hour is effective in doing this (Dias *et al*., 2003).

The significant increase in the seedling growth was obtained when seeds were soaked in urea solution. This may be due to greater meristematic activity at the growing point as influenced by the seedsoaking with urea. This finding is in accordance with the result of Peixoto and Carvalho (1996).

The performance of 5 per cent H_2SO_4 (3 min dip) soaked seed produced significantly higher germination

of seed as compared to water soaked seed and control. The probable cause of this may be due to hard seed coat which were softened by conc. sulphuric acid resulting easy emergence of seedling. This result is in agreement with the result of Singhrot and Makhija (1979). They got 82 per cent germination from 3 minutes acid soaked seeds.

The effect of thiourea was also found conducive in increasing germination of seeds. Higher concentration of thiourea (500 ppm) was found to be best with 80.55 per cent germination than lower concentration. The enhancement of germination due to thiourea may be attributed to cytokinin like activity which is known to promote seed germination (Thomas, 1977). The finding is in accordance with the finding of Krishnan and Kulasekaran (1984), they reported 92 per cent germination with thiourea at 500 ppm.

Seeds soaked in sucrose showed better performance compared to control. Sugar is a good respiratory substrate for the maintenance of osmotic potentiality. Sucrose supplemented endogenous carbohydrates utilized during germination of seed. Similar beneficial effect of sucrose was reported in pea by Kumar (1999).

Water soaking of seeds is done to modify hard seed coats, remove inhibitors, soften seeds and reduce the time of germination. Hence, soaking in plane water was better than dry seeding. This result is in agreement with the result of Wangner-Junior *et al.* (2005).

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