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Pallavi SP
Department of FSC, KRC College of Horticulture, Arabhavi, Karnataka, India

Dileepkumar A Masuthi
Department of Seed Science and Technology, KRC College of Horticulture, Arabhavi, Karnataka, India

Anil I Sabarad
Department of FSC, KRC College of Horticulture, Arabhavi, Karnataka, India

Nagesh H Naik
Department of FSC, College of Horticulture, Sirsi, Karnataka, India

Gollagi SG
Department of Crop Physiology, HREC (T), Vijayapura, Karnataka, India

Nataraj KH
Department of FSC, KRC College of Horticulture, Arabhavi, Karnataka, India

Corresponding Author:
Pallavi SP
Department of FSC, KRC College of Horticulture, Arabhavi, Karnataka, India

Influence of pre-germination treatments on germination, growth and vigour of passion fruit (*Passiflora edulis* var *flavicarpa*) seeds

Pallavi SP, Dileepkumar A Masuthi, Anil I Sabarad, Nagesh H Naik, Gollagi SG and Nataraj KH

Abstract
The germination of passion fruit seeds is less and uneven. Hence, an experiment was conducted during 2020-2021 to study the effect of pre-germination treatments on germination, growth and vigour of passion fruit. The study revealed significant differences among the treatments. Maximum germination percentage (59.48%) was observed in seeds treated with thiourea @ 1 per cent. Maximum seedling height 8.66 cm, 24.71 cm and 26.54 cm in thiourea treatment and number of leaves 3.47, 7.73 and 9.47 were observed in seeds treated with GA_3 250 ppm at 30, 60 and 90 days respectively. Vigour index-I (1571) and Vigour index-II (82.38), maximum fresh and dry weights of shoot were 6.50g and 1.38g respectively in thiourea treated seeds. The use of pre-germination treatments is therefore recommended as an approach for germination of passion fruits.

Keywords: Passion fruit, pre-germination treatments. Germination, vigour

1. Introduction
Passion fruit is botanically called as *Passiflora edulis* belongs to the family passifloraceae and found in tropical America (Brazil). It is known for its wonderful aroma, flavor and medicinal as well as nutritional importance. Fruits are rich in copious amount of Vitamin A, Vitamin C and mineral salts. It is commercially cultivated in countries like Kenya, Australia, New Zealand, Hawaii, South Africa and Srilanka (Sema and Maiti, 2009) [14].

The genus passiflora comprising about 500 species, out of which 50 species bears edible fruits. But only two species are commercially cultivated *i.e*, *Passiflora edulis var edulis* (Purple passion fruit) and *Passiflora edulis var flavicarpa* (Yellow passion fruit). Some of the other important species are *P. quadrangularis*, *P. incarnata*, *P. ligularis*, *P. laurifolia* are cultivated in limited scale for local consumption (Ramaiya *et al*., 2018) [13].

Thirty to forty per cent juice content extracted from passion fruit can be consumed fresh, used as concentrate or as flavour in some foods (Alegbejo, 2004) [1]. The fruit is eaten alone or in fruit salads, *sherbet*, ice cream, jams, cool drinks. The yellow variety is used for juice processing whereas, the purple type has been sold in fresh fruit markets. The fruit has been used by the Brazilian tribes as a heart tonic as their favourite drink called maracuja grande that is commonly used to treat asthama, bronchitis, whooping cough and other tough coughs. The fruit still occupies a prominent place in South American and Peruvian traditional medicine.

The rind is used in cattle and pig feed, the glycoside passiflorine which is extracted from dried flowers used as a sedative or tranquilizer. The fruit juice acts as a digestive stimulant, treatment for gastric ulcer, urinary infections and as mild diuretic. Besides, the oil extracted from the passion fruit seeds has properties which is similar to sunflower and soybean oil, is edible and has industrial importance (Baiyeri *et al*., 2011) [3].

In India however, the cultivation of passion fruit is confined to limited area due to lack of awareness about crop and also lack of planting materials. To increase the productivity, there should be availability of good quality planting material along with proper management practices. The vine can be propagated sexually through seeds and asexually through cuttings, layering, grafting and tissue culture, however in most cases through seeds. It ensures plant health as crop diseases are not transmitted by seeds. Seed propagation is also recommended for rootstock production and plant breeding program focused on disease-resistant and drought-tolerant hybrids with medicinal and ornamental use.

The germination of passion fruit seeds is less and uneven which may be due to physical (integument impermeability to water and gas), chemical (presence of inhibitory substances), physiological immaturity (mechanisms of germination inhibition), embryo immaturity (Favaris *et al*., 2020) [7]. Pre-germination treatments may enhance the germination potential of passion fruit seeds.

Passion fruit seeds can present different forms and levels of dormancy and cases in which more than one type occurs are known as complex dormancy (Delanoya *et al*., 2006) [5]. Hence, the investigation was carried out at Department of Fruit Science, Kittur Rani Channamma College of Horticulture, Arabhavi to study the influence pf different pre-germination treatments on germination, growth and vigour of passion fruit seeds.

2. Material and Methods

2.1 Details of the experimental site

The experiment was conducted at the K.R.C. college of Horticulture, Arabhavi, of the University of Horticultural sciences, Bagalkot, in Karnataka, India. Arabhavi is situated in Northern dry Zone of Karnataka state (Zone NO.3, Region-2) at 16°15' N latitude and 74°45' E longitude, 612 m above mean sea level. The experimental sites receive, on an average, about 550 mm rain annually.

2.2 Experimental details

The present investigation was carried out during the year 2020- 2021 at K.R.C. College of Horticulture, Arabhavi in Belgaum district of Karnataka. The experiment was laid in completely randomized design with seven treatments with three replications. Observations were recorded in respect of seedling height and number of leaves at 30, 60 and 90 days interval. Germination percentage was recorded. The germination percentage was worked out after complete germination, i.e., after stoppage of germination. It was calculated by dividing total number of seeds sown with the number of seeds germinated and was multiplied by 100. Fresh and dry weights of seedlings were also recorded. Seedling vigour was calculated based on the following formula (Bewley and Black, 1982).

Vigour index I = Per cent germination × Length of seedling
Vigour index II = Per cent germination × Total dry weight of seedling

2.3 Treatment details

T_1: Thiourea (1%) for 10 minutes
T_2: GA_3 (250 ppm) for 10 minutes
T_3: Seeds immersed in hot water at 50 ºC for 10 minutes
T_4: Quick dipping of seeds in sulphuric acid (98%)
T_5: Soaking of seeds in lemon juice for 15 hrs
T_6: Overnight soaking of seeds in sucrose solution (10%)
T_7: Control

3. Result and Discussion

3.1 Germination

The germination per cent was maximum in Thiourea (59.48%) followed by GA3 500 ppm (49.33%) whereas the minimum germination per cent was recorded in control (30.93%). The improved germination with thiourea might be due to strong neutralizing effect of thiourea on inhibitor present in seed or might be due to the increased cytokinine activity by thiourea in overcoming the seed coat inhibiting effect (Hore and Sen, 1994) [8]. The result obtained from the study was supported by the work done by Dhankhar and Singh (1996) [6] and Rajamanickam *et al*. (2002) [12] in aonla. Enhanced percentage of germination because of the growth regulators like GA_3 is probably due to its effect to bring about a favourable internal condition (breaking of seed dormancy) for maximum germination. With the imbibed water, the embryo got activated and the process of germination is initiated. GA_3 synthesized by the enlarged embryo acts on the living cells and helps in synthesis of hydrolyzing enzymes particularly amylase and protease. The hydrolysed food is utilized for the growth of embryo (Paleg, 1960) [11]. These findings are also reported by Kalalbandi *et al*. (2003) [9] in Kagzi lime, Shirol *et al*. (2006) [15] in Khirni and Morestega *et al*. (2017) in passion fruit.

Growth parameters

The various vegetative growth parameters such as seedling height and number of leaves were found to be significant among the different treatments (Table 1). Seeds treated with thiourea at 1 per cent significantly recorded highest shoot length (8.66 cm, 24.71 cm and 26.54 cm) at 30, 60 and 90 days after sowing respectively and there was maximum percentage increase in seedling height from 30 to 60 days. Increased seedling height may be attributed to the reason that thiourea increased the plant height by stimulating photosynthetic activities that resulted in vigorous growth and enhancement in seedling height resulting in and better plant growth as reported by (Asthir *et al*., 2013) [2]. Similar results were reported by Tripathi *et al*. (2006) [16] in walnut. The number of leaves per seedling was significantly influenced by pre-germination treatments at monthly interval. Seeds treated with thiourea at 1 per cent significantly recorded highest number of leaves (3.73) and) at 30 days after sowing and seeds treated with GA_3 250 ppm for 10 minutes recorded significantly maximum number of leaves (7.13 and 9.47) at 60 and 90 days after sowing. Increase in the number of leaves per seedling with thiourea might be due to the reason that thiourea transports N from source to sink that regulates photosynthesis and increased leaf number as reported by (Uddin *et al*., 2020) [17].

Seedling quality parameters

The maximum shoot length (26.54 cm) was recorded in seeds treated with thiourea @ 1 per cent which was on par with sucrose solution treatment at 10 per cent (26.40 cm). The root length was also found significantly higher in thiourea @ 1per cent for 10 min (15.91 cm) followed by lemon juice treatment for 15 hours (10.87 cm). Significant differences were found between the treatments with respect to fresh and and dry weight of the seedling (Table 2). Maximum fresh shoot and root weight was recorded in seeds treated with thiourea @ 1 per cent (6.50g and 1.38g) which was found to be statistically on par with lemon juice treatment (5.75g and 1.30g). The increased fresh and dry weight of seedling may be due to the enhanced root and shoot length. Thus the increase in root and shoot length and number of leaves have lead to the overall assimilation and redistribution of photosynthates within the plant and resulted in higher fresh and dry weight of seedling and increased dry matter assimilation (Choudhary and Chakrawar, 1982). Vigour index-I was found to be significantly highest (Table-2) in thiorea treatment (1571)

which was statistically on par with lemon juice treatment (1244). This might be due to increase germination and seedling height which have contributed to higher vigour index-I. Vigour index-II was found to be maximum (Table-2) in thiourea at 1 per cent (82.38) which was statistically on par with lemon juice treatment (64.72) the reason might be attributed to the increased dry matter production in the concerned treatments. (Rajamanickam *et al*., 2002) [12].

Table 1: Effect of pre-germination treatment on germination and vegetative parameters of passion fruit at different stages of growth

Treatments	Germination percentage (%)	Seedling height			Number of leaves		
		30 DAS	60 DAP	90 DAS	30 DAS	60 DAS	90DAS
T_1	59.48 (50.44)	8.66	24.71	26.54	3.73	7.13	8.83
T_2	49.33 (44.94)	7.46	19.38	22.67	3.47	7.73	9.47
T_3	47.74 (43.69)	7.73	21.38	25.59	3.40	7.33	9.27
T_4	33.76 (35.50)	7.13	17.69	20.73	2.90	5.13	6.51
T_5	48.54 (44.07)	7.09	23.90	25.35	3.20	6.47	7.93
T_6	42.35 (40.56)	6.96	22.46	26.40	2.97	6.40	7.57
T_7	30.93 (33.72)	5.76	14.39	18.43	3.20	7.07	7.73
S.Em+	4.23	0.21	1.39	1.37	0.11	0.33	0.22
C.D. at 5%	17.81	0.89	5.86	5.77	0.47	1.39	0.95

Note: *Values in parentheses are arc sign transformed data, DAS- Days After sowing

Table 2: Effect of pre-germination treatments on seedling quality parameters in passion fruit seedlings after 90 days after sowing

Treatment	Shoot length (cm)	Root length (cm)	Fresh weight (g)	Dry weight (g)	SVI-I	SVI-II
T_1	26.54	15.91	6.50	1.38	1571	82.38
T_2	22.67	10.34	5.51	1.10	1145	56.13
T_3	25.59	9.91	5.13	0.98	1226	47.01
T_4	20.73	9.80	3.62	0.75	703	24.90
T_5	25.35	10.87	5.75	1.30	1244	64.72
T_6	26.40	8.35	4.30	0.76	1135	31.89
T_7	18.43	8.33	4.60	0.85	572	26.42
S.Em±	1.37	0.87	0.43	0.10	150.96	8.28
CD @ 1%	5.77	3.68	1.80	0.43	635.53	34.84

SVI- Seedling vigour index

4. Conclusion

Germination of passion fruit seeds can be enhanced when seeds were treated with thiourea at 1 per cent for 10 minutes as it resulted in maximum seedling height, root length, fresh weight of the seedling and dry weight of the seedling. The next best result obtained when seeds soaked in GA_3 at 250 ppm for 10 min which records minimum days taken for initiation of germination and maximum number of leaves.

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