Effect of light and GA_3 on germination of Purple Passion Fruit (*Passifloraedulis*Sims*)* seeds

ABSTRACT

The present study was carried out to investigate the effect of light and GA_3on the germination of purple passion fruit (*Passifloraedulis*sims) under agro climatic condition of Prayagraj. The perforated polythene bags of 4 x 5 cm size (150 gauges thickness) were used for sowing. The bags were filled with a mixture of farmyard manure (FYM), sand and soil in the ratio of 1:1:1. Pre-sowing-dip method was adopted for seed treatment. The treatments included application of [T_0: Shade net(light 20,100), T_1: $GA_3$200 ppm + light 24,500 lux,T_2:$GA_3$200 ppm + light 30,100 lux,T_3: $GA_3$250 ppm + light 24,500 lux,T_4:$GA_3$250 ppm + light 30,100 lux, T_5: $GA_3$300 ppm + light 24,500 lux,T_6: GA_3 300 ppm + light 30,100 lux,T_7:$GA_3$350 ppm + light 24,500 lux, T_8: $GA_3$350 ppm + light 30,100 lux]. The experiment was laid in randomized block design with nine treatments and was replicated three times. TreatmentT_8 performed best in term day to 1st germination(20.01), day to 50% germination(26.68), day to complete germination(35.25),germination percentage(89.09), seed vigour index(1400.48),seedling height(10,20,30,40 days) (10.37,11.50,13.69,16.25), number of leaves(10,20,30,40 days) (3.00,4.78,6.22,9.45), shoot length(10,20,30,40 days) (4.68,4.97,5.05,5.20), root length(10.66), shoot: root(0.62),stem girth(2.70),chlorophyll content(43.37) and survivality percentage(83.65).

Key words:-Light, GA_3, germination, seed vigour index and seedling growth, Purple Passion Fruit

1.INTRODUCTION

"Species within the Passifloraceae family are primarily native to regions with tropical climates. Passiflora is a large genus in the family Passifloraceae consisting of approximately 500 species, most of which are cultivated for edible fruits, pharmaceutical properties, and ornamental characteristics. Most species are herbaceous, perennial vines with a rapid growth rate. Some of them like maypop (P. incarnata) are considered weeds due to their rampant growth" (**Amir and Eric 2018). "**Passion fruit is botanically called as Passifloraedulis 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 Sri Lanka"**(Sema and Maiti, 2009).**"The genus Passiflora comprising about 500 species, out of which 50 species bears edible fruits. But only two species are commercially cultivated i.e, Passifloraedulisvaredulis (Purple passion fruit) and Passifloraedulisvarflavicarpa (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).***"*The low rate of Passiflora seed germination may be caused by exogenous dormancy, which may be a result of both chemical and mechanical dormancy, with the latter occurring

because the seeds contain inhibitors" (Delanoy et al., 2006)**.** In this regard, studies on germination of *P. ligularis* are scarce. During germination, GA_3 induces the synthesis of hydrolytic enzymes, such as amylase and protease. These enzymes degrade the stored food reserves accumulated in the endosperm or embryo as the seed matured. This degradation of carbohydrate and storage protein provides nourishment and energy to support germination and seedling growth. Gibberellins (GA_3) activate the embryonic vegetative growth, weakens the endosperm layer that involves the embryo and restricts its growth, and mobilizes the energetic reserves from the endosperm of cereals **(Taiz and Zeiger, 2006) and Hota*et al.*, (2018).** Light is an extremely important factor for seed germination. However, there is disagreement in the response from different species to the absence or presence of this condition. For some species, the influence of light is favorable for germination, and for others it is negative or indifferent. This is because the light is responsible for the activation of phytochrome, a soluble chromoprotein which in the inactive form (Fv), absorbs red (R) wavelength and is transformed into an active (Fve) one **(Taiz and Zeiger, 2013).** Thus, this study was taken up to know the role of different concentration of GA_3 and light on seed germination of purple passion fruit.

2.MATERIALS AND METHODS

2.1 Study Location

The study was conducted at, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, located in Prayagraj, Uttar Pradesh, India. Prayagraj is located in the south-east part of Uttar Pradesh India. Prayagraj falls under agroclimatic zone IV which is named as "middle Gangetic plains" the site of experiment is located at 25.57º N latitude 81.51º E longitude and 98 meter above the sea level the temperature falls down as low as 4-5º during winter, the average rainfall in this area is around 798.900 mm annually with maximum concentration during July to September with few showers and drizzles in winter also.

2.2 Layout and Treatment Combination

The experimental was carried out to study the "Effect of light and GA_3 on seed germination of Purple Passion Fruit (*Passifloraedulis*Sims.)" in the experimental laboratory of Horticulture and field Experimentation Centre of Department of Horticulture, at the department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, (Uttar Pradesh), during 2023-24.The experimental design was RBD and there were nine treatments which are replicated thrice. The treatment details are T_0-Shade net(light 20,100), T_1-$GA_3$200 ppm + light 24,500 lux,T_2-GA3200 ppm + light 30,100 lux,T_3-GA3250 ppm + light 24,500 lux,T_4-GA3250 ppm + light 30,100 lux,T_5-GA3300 ppm + light 24,500 lux,T_6-GA3 300 ppm + light 30,100 lux,T_7-GA3350 ppm + light 24,500 lux and T_8-$GA_3$350 ppm + light 30,100 lux.The perforated polythene bags of 4 x 5 cm size (150 gauges thickness) were used for sowing. The bags were filled with a mixture of farmyard manure (FYM), sand and soil in the ratio of 1:1:1. Before sowing the seeds in the polythene bags, seeds were treated with GA_3. Two seeds were sown in each polythene bags. Regular watering with water-can was done gently in morning and evening. Pre-sowing dip method was adopted for seed treatment. Growth regulators of different concentrations were poured in required

quantity into the labeled beakers. The observations were recorded for day to 1st germination, 50 % germination, day to complete germination, germination percentage and seed vigour index, seedling height, number of leaves, shoot length, root length, shoot: root, stem girth, chlorophyll content, survivality percentage. The experimental data collected relating to different parameters were statistically analyzed by RandomizedBlock Design (RBD) and results were analyzed as per the guide lines suggested by Panse and Sukhatme (1985).

3.RESULTS AND DISCUSSION

3.1 Germination Parameter

3.1.1 Day to 1st germination

Theeffect of light and GA_3 showed significant differences on day to 1st germination. The minimum day to 1st germination20.01 percentage was recorded in $GA_3$350ppm + light 30,100 lux, While the maximum Day to 1st germination 38.05 percentage respectively were recorded in Shade net(light 20,100). However, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux..The remarkable effect of GA_3on minimum days required for germination might be due to it acts on the embryo and causes denova synthesis of hydrolyzing enzymes particularly amylase and protease and this hydrolyzed food is utilized for growth of embryo and thereby enhanced the germination. The effect of GA_3 on higher seed germination percentage might be due to the involvement of GA_3 in the activation of cytological enzymes along with increase in cell wall plasticity and better water absorption. These results are in agreement with the findings of **Vachhani et al. (2014) in khirni; Reshma and Simi (2019)** in mango.

3.1.2 Day to 50 % germination

Theeffect of light and GA_3 showed significant differences on day to 50 % germination. The minimum day to 50 % Germination 26.68 percentage recorded in $GA_3$350 ppm + light 30,100 lux, While the maximum 50 % Germination 44.72 percentage respectively were recorded in Shade net(light 20,100). However, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux.

3.1.3 Day to complete germination

Theeffect of light and GA_3 showed significant differences. The minimum Day to complete germination 35.25 percentage recorded in $GA_3$350 ppm + light 30,100 lux, While the maximum Day to complete germination 53.28 percentage respectively were recorded in Shade net (light 20,100). However,$GA_3$350 ppm + light 24,500 lux are found statistically at par to $GA_3$350 ppm + light 30,100 lux.

3.1.4 Germination percentage

Theeffect of light and GA_3 showed significant differences on germination percentage. The maximum Germination percentage 89.69 percentage recorded in $GA_3$350 ppm + light 30,100 lux, While the minimum Germination percentage 68.66 percentage respectively were recorded in Shade net(light 20,100). However,$GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux. GA_3 induces the denovo synthesis of proteolytic enzymes like α-amylase and ribonuclease. Amylases in turn hydrolyse starch in

the endosperm, providing the essential sugars for the initiation of growth processes. GA_3 treatment is also known to overrule the photo dormancy, thermo-dormancy, dormancy imposed by incomplete embryo development, mechanical barriers, and presence of germination inhibitors. The result was in agreement with findings of **Praveen *et al.*, (2006)** in custard apple and **Muralidhara*et al.*, (2015)** in mango **Lalitha*et al.*, (2020**

3.2 Growth Parameters

3.2.1 Seedling Height (cm)

The effect of light and GA_3 showed significant differences on seedling height (cm)at 10, 20, 30 and 40 days after germination of Purple Passion Fruit (*Passifloraedulis*Sims*).* The maximum seedling height was observed in $GA_3$350 ppm + light 30,100 lux with (10.37, 11.50,13.69 and 16.25). While the minimum seedling height (5.60, 6.34,8.02 and 10.22) respectively were observed in Shade net(light 20,100) at 10, 20, 30 and 40 days after germination. However, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux.Aatla and Srihari, (2013) reported that treatment of mango cv. Alphonso kernel with GA3500 ppm resulted in greater seedling height and internodal length. Increased shoots length with GA3treatment might be because it activated amylase, which digested the available carbohydrate into simple sugars so that energy and nutrition were easily available to faster growth of seedling **Aatla and Srihari, (2013) .** GA3 increased cell division and cell growth apparently leading to increased development of young leaves. Therefore, from the present study it is evident that the maximum number of leaves per seedling with GA3may be attributed to increase the physiological process and stimulatory action of GA3to form new leaves at faster rate. **Archana et al., (2015)** reported similar results in Annona squasmosa, Ramchandra and Govind, in guava and **Dinesh and Padmapriya (2022).**

3.2.2 Number of leaves

The effect of light and GA_3 showed significant differences on number of leaves per seedlingat 10, 20, 30 and 40 days after germination of Purple Passion Fruit (*Passifloraedulis*Sims*).* The maximum number of leaves per seedling was observed in $GA_3$350 ppm + light 30,100 lux with (3.00, 4.78, 6.22 and9.45). While the minimum number of leaves per seedling (2.00, 2.56, 3.56 and 5.78) respectively were observed in Shade net(light 20,100)at 10, 20, 30 and 40days after germination.However, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux.GA3 pre-soaking can be correlated with higher seed germination, higher shoot length and root length and number of leaves has lead to over all assimilation and distribution of food material with the plant **(Brain and Hemming,1955)** and hence resulted in higher seedling vigour**(Pampanna and Sulikeri, 2001).** The results were in close agreement with the Pampanna and Sulikeri (2001) in sapota; **Kumar et al. (2011), Padma Lay et al. (2013) andAmit Desai et al. (2017)** in papaya.

3.2.3 Shoot length (cm)

The effect of light and GA_3 showed significant differences on shoot length (cm)at 10, 20, 30 and 40 days after germination of Purple Passion Fruit (*Passifloraedulis*Sims*).*The maximum

shoot length (cm) was observed in $GA_3$350 ppm + light 30,100 lux with (4.68, 4.97, 5.05 and 5.21). While the minimum shoot length (cm) (3.56, 4.01, 4.23 and 4.30) respectively were observed in Shade net(light 20,100)at 10, 20, 30 and 40days after germinationHowever, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux

3.2.4 Root length (cm)

The effect of light and GA_3showed significant differences on root length (cm)of Purple Passion Fruit (*Passifloraedulis*Sims*)* seeds. The maximum root length (10.66) was recorded in T_8 $GA_3$350 ppm + light 30,100 lux. whereas the minimum Root length (6.97) was found recorded in Shade net(light 20,100) respectively. However, $GA_3$350 ppm + light 24,500 lux are found statistically at par to $GA_3$350 ppm + light 30,100 lux.

3.2.5 Seed vigour index

Theeffect of light and GA_3 showed significant differences on seed vigour index. The maximum seed vigour index (1400.48) was recorded in $T_8GA_3$350 ppm + light 30,100 lux. Where as the minimum seed vigour index (701.93) was found recorded in Shade net(light 20,100) . However, $GA_3$350 ppm + light 24,500 lux are found statistically at par to $GA_3$350 ppm + light 30,100 lux.

3.2.6 Shoot: root

The effect of light and GA_3showed significant differences onshoot : rootof Purple Passion Fruit (*Passifloraedulis*Sims*)* seeds.The maximum shoot : root (0.62) was recorded in T_8 $GA_3$350 ppm + light 30,100 lux. whereas the minimum shoot : root (0.49) was found recorded in Shade net(light 20,100) respectivelyHowever, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux.. **Ravishankar et al., (2020)** also reported the similar results.

3.2.7 Stem girth (mm)

The effect of light and GA_3showed significant differences on stem girth (mm) of Purple Passion Fruit (*Passifloraedulis*Sims*)* seeds.The maximum stemgirth(mm) (2.70) was recorded in T_8 $GA_3$350 ppm + light 30,100 lux. Where as the minimum stemgirth(mm) (1.86) was found recorded in Shade net(light 20,100) respectively. However, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux.. **Choudhary et al., (2018)** and **Kumawat et al., (2014)** also reported the similar results.

3.2.8 Chlorophyll content (spad)

The effect of light and GA_3showed significant differences on chlorophyll contentof Purple Passion Fruit (*Passifloraedulis*Sims*)* seeds.The maximum Chlorophyll content (43.37) was

recorded in T_8 $GA_3$350 ppm + light 30,100 lux. Where as the minimum Chlorophyll content (25.95) was found recorded in Shade net(light 20,100) respectively. However, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux.These findings are in agreement with the results obtained by **Lay et al. (2015)** in papaya. The different levels of GA3 did not affect significantly to increase chlorophyll content.

3.3 Survival and Establishment

3.3.1 Survivality percentage

The effect of light and GA_3showed significant differences on survivalitypercentage of Purple Passion Fruit (*Passifloraedulis*Sims*)* seeds.The maximum Survivalitypercentage (83.65) was recorded in T_8 $GA_3$350 ppm + light 30,100 lux. Where as the minimum Survivality % (32.87) was found recorded in Shade net(light 20,100) respectively. However, $GA_3$350 ppm + light 24,500 luxare found statistically at par to $GA_3$350 ppm + light 30,100 lux.The application of GA3 might have boosted the early germination and growth of seedling by cell multiplication and cell elongation subjected to the better plant growth resulting higher rate of seedling survival. This might be due to rapid and early germination which resulted in giving more periods for vegetative growth for better establishment of plants **(Sharma et al., 2012).** The combination of growing media and GA3 significantly promoted the germination and growth by multiplication and elongation of plant cell. On the other hand, the improved soil condition, soil health, availability of the nutrients, might be supported to appropriate cation exchange capacity and water holding capacity. Thus permitting adequate moisture exchange of gases uptake of nutrients facilitate better and healthy growth resulting maximum survival of seedling under the treatments **Parmar et al., (2019).**

3.3.2 Economics

Due to the increase in germination percentage and survivality percentage as showed in (table 1 and 3), the used of $GA_3$350 ppm + light 30,100 lux (T_8) for the preparation of passion fruit seedling have proved to be profitable and showed maximum net return (Rs. 13337.50/1000 seedlings) and B:C (2.76) for the experiment.

Table 1 Effect of light and GA_3 on Germination Parameters and seed vigour index of purple Passion fruit (*Passifloraedulis*sims)

Notion	Treatment details	Germination Parameters				Seed vigour index
		Day to 1st	50 % Germinat	Day to complete	Germination percentage	

		germination	ion	germination		
T_0	Shade net(light 20,100)	38.05	44.72	53.28	68.66	701.93
T_1	$GA_3$200 ppm + light 24,500 lux	31.32	41.84	50.40	71.76	824.51
T_2	$GA_3$200 ppm + light 30,100 lux	26.09	32.76	41.33	74.56	797.49
T_3	$GA_3$250 ppm + light 24,500 lux	31.25	37.92	46.48	74.25	820.22
T_4	$GA_3$250 ppm + light 30,100 lux	28.95	35.61	44.18	78.64	1079.78
T_5	$GA_3$300 ppm + light 24,500 lux	26.81	33.48	42.04	78.64	1198.02
T_6	GA_3 300 ppm + light 30,100 lux	24.64	37.99	46.56	80.59	1069.10
T_7	$GA_3$350 ppm + light 24,500 lux	31.30	35.17	39.87	84.08	1366.08
T_8	$GA_3$350 ppm + light 30,100 lux	20.01	26.68	35.25	89.09	1400.48
F Test		**S**	**S**	**S**	**S**	**S**
S.Ed(±)		**1.48**	**1.48**	**2.45**	**3.46**	**68.68**
CV		**5.98**	**5.28**	**6.76**	**5.45**	**246.98**
CD at 0.5%		**3.14**	**3.14**	**5.19**	**7.34**	**136.98**

Table 2 Effect of light and GA_3 on seedling growth parameters of purple Passion fruit (*Passifloraedulis*sims)

Notion	Treatment	Seedling height(cm) (Day after germination)	Number of leaves per seedling (Day after germination)	Shoot length (cm) (Day after germination)

		10 Days	20 Days	30 Days	40 Days	10 Days	20 Days	30 Days	40 Days	10 Days	20 Days	30 Days	40 Days
T_0	Shade net(light 20,100)	5.60	6.34	6.83	10.22	2.00	2.56	3.56	5.78	3.56	4.01	4.23	4.30
T_1	$GA_3$200 ppm + light 24,500 lux	5.72	6.70	8.02	11.49	2.11	3.11	4.00	6.44	3.76	4.11	4.59	4.63
T_2	$GA_3$200 ppm + light 30,100 lux	5.83	7.14	7.58	10.70	2.44	3.11	4.00	6.22	3.68	4.53	4.58	4.84
T_3	$GA_3$250 ppm + light 24,500 lux	5.95	7.19	8.08	11.05	2.22	3.22	4.00	6.78	3.82	4.71	4.78	5.05
T_4	$GA_3$250 ppm + light 30,100 lux	7.24	9.19	9.70	13.73	2.11	4.00	5.11	6.11	3.67	4.60	4.64	5.07
T_5	$GA_3$300 ppm + light 24,500 lux	7.28	9.46	9.50	15.23	2.11	3.11	5.11	8.78	3.88	4.49	4.97	5.08
T_6	GA_3 300 ppm + light 30,100 lux	8.14	8.49	11.29	13.27	2.45	4.11	5.89	8.33	3.97	4.59	4.98	5.19
T_7	$GA_3$350 ppm + light 24,500 lux	9.10	10.63	11.39	15.72	2.67	4.45	6.00	8.78	4.26	4.95	5.04	5.20
T_8	$GA_3$350 ppm + light 30,100 lux	10.37	11.50	13.69	16.25	3.00	4.78	6.22	9.45	4.68	4.97	5.05	5.21
	F Test	**S**	**S**	**S**	**S**	**NS**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	S.Ed (±)	**0.72**	**1.90**	**1.06**	**1.17**	**0.22**	**0.24**	**0.32**	**0.55**	**0.37**	**0.39**	**0.53**	**0.31**
	CV	**12.11**	**25.05**	**14.93**	**10.94**	**11.86**	**8.24**	**8.03**	**9.11**	**11.71**	**10.41**	**13.71**	**7.83**
	CD at 5%	**1.53**	**4.03**	**2.26**	**2.48**	**0.47**	**0.51**	**0.68**	**1.17**	**0.79**	**0.82**	**1.13**	**0.66**

Table 3 Effect of light and GA_3 on root length, shoot:root, stem girth(mm), chlorophyll content and Survivality % of purple Passion fruit (*Passifloraedulis*sims)

Notion	Treatment details	Root length (cm)	Shoot : root	Stem girth (mm)	Chlorophyll content	Survivality %

T_0	Shade net(light 20,100)	6.97	0.49	1.86	25.95	32.87
T_1	$GA_3$200 ppm + light 24,500 lux	7.60	0.54	2.00	28.4	45.98
T_2	$GA_3$200 ppm + light 30,100 lux	7.90	0.61	2.16	32.58	53.59
T_3	$GA_3$250 ppm + light 24,500 lux	8.20	0.58	2.19	32.44	61.84
T_4	$GA_3$250 ppm + light 30,100 lux	8.50	0.60	2.26	31.63	63.19
T_5	$GA_3$300 ppm + light 24,500 lux	8.90	0.57	2.43	35.16	71.49
T_6	GA_3 300 ppm + light 30,100 lux	9.50	0.55	2.54	35.29	81.59
T_7	$GA_3$350 ppm + light 24,500 lux	9.60	0.54	2.66	42.3	82.84
T_8	$GA_3$350 ppm + light 30,100 lux	10.66	0.62	2.70	43.37	83.65
F Test		**S**	**S**	**S**	**S**	**S**
S.Ed(±)		**0.548**	**0.012**	**0.032**	**4.73**	**2.345**
CV		**7.756**	**0.48**	**0.421**	**16.96**	**9.858**
CD at 0.5%		**1.161**	**0.023**	**0.065**	**10.02**	**4.681**

CONCLUSION

On the basis of our experimental finding, it can be concluded that the best result was found in treatment T_8 (GA_3 350 ppm + light 30,100 lux) in term day to 1st germination(20.01), day to 50% germination(26.68), day to complete germination(35.25),germination percentage(89.09),seed vigour index(1400.48),seedling height(10,20,30,40 days)(10.37,11.50,13.69,16.25), number of leaves(10,20,30,40 days)(3.00,4.78,6.22,9.45),

shoot length(10,20,30,40 days)(4.68,4.97,5.05,5.20), root length(10.66), shoot: root(0.62),stem girth(2.70),chlorophyllcontent(43.37) and survivality percentage(83.65).

The highest B:C ratio was found in T_8 (GA_3 350 ppm + light 30100 lux) with 2.76.

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