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Effect of gibberellic acid and growing media on seed germination, growth and vigour of papaya (*Carica papaya* L.) seedling

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Abstract
An experiment entitled "Effect of Gibberellic acid and growing media on seed germination, growth and vigour of papaya (*Carica papaya* L.) Seedling" was conducted during 2020-21 at the Horticulture Research Farm, under Pt. Kishorilal Shukla College of Horticulture & Research Station, Rajnandgaon, Chhattisgarh. The experiment was laid out in factorial completely randomized design (FCRD), which included 28 treatments with 3 replications; there were two factors which comprised seven levels of different growing media and four levels of growth regulators. The treatment combination of soil: sand: vermicompost; in 1:1:1 ratio along with 100 ppm (M_2G_1) showed better for seed germination, root growth parameters and survival percentage and combination of growing media soil: sand: rice husk: vermicompost; in 1:1:1:1 ratio with GA_3 100 ppm (M_5G_1) was found better for shoot growth parameters and survival percentage, hence both treatment combination M_2G_1 and M_5G_1 was found to be most suitable and may be recommended for raising of quality planting material of papaya.

Keywords: Papaya, GA_3, vermicompost, FYM, rice husk, germination, seedling

Introduction
Papaya (*Carica papaya* L.) is an important fruit crop in tropical and subtropical regions of the world as well as in kitchen gardens due to its quick growth and early bearing habit. It belongs to the family Caricaceae and its native place is Tropical America. India is the largest producer of papaya, contributing 45% of global production. The major growing states of papaya in India are Karnataka, Gujarat, Orissa, West Bengal, Assam, Kerala, Chhattisgarh, Madhya Pradesh, and Maharashtra. The total area of papaya in India is 142 thousand ha, with an annual production of 6011 thousand MT (Anon., 2019a) [1]. In Chhattisgarh, the area under papaya cultivation is 14.40 thousand ha with a production of 381.42 thousand MT and a productivity of 26.48 MT/ha (Anon., 2019b) [2]. In Chhattisgarh, it is mainly cultivated in Durg, Raipur, Bilaspur, Mahasamund, and Bemetara.
Papaya is normally propagated by seed (Cheema and Dhani, 1930) [3]. Many papaya growers face the problem of slow, erratic and incomplete germination. The slow and asynchronous germination is attributed due to the presence of inhibitors (mainly phenolic compounds) in the sarcotesta and seed coat (Reyes *et al.* 1980) [19].
A growing medium can be defined as a substance through which plant roots grow and extract water and nutrients. Selecting a good growing medium is fundamental to good nursery management and is the foundation of a healthy root system (Mishra *et al.* 2017) [12]. Seed treatment promotes seed germination and minimises the germination time with suitable growing media. Gibberellic acid (GA_3) can stimulate rapid stem and root growth, induce mitotic division in the leaves of some plants, and increase seed germination rate. The seeds of papaya are enclosed within a gelatinous sarcotesta (aril, or outer seed coat which is formed from the outer integument.) which can prevent germination (Yahiro, 1979) [20]. Before sowing of seeds is soaking in water or water soluble endogenous hormones has been reported to promote the germination (Desai *et al.* 2017) [6].
Growing media serves as a growing medium as well as a fertilizer source for plant growth. Vermicompost delivers sufficient oxygen to roots, as well as appropriate water and nutrient retention for plants; certain beneficial compounds improve nutrient availability, affecting plant development, production, and quality. FYM is porous and has a high water holding capacity, allowing for optimum moisture and gas exchange between the growing medium and the embryo.

Cocopeat is a good growth media constituent because of its pH, electrical conductivity, and other chemical properties (Ramteke *et al.* 2015) [17]. Rice husk is a by-product of the milling industry and is one of the important agricultural waste materials used as a growing medium. It acts as a sorbent for nutrients due to the presence of high silica content (Radha *et al.* 2018) [16].

The cost of many gynodioceious cultivars of papaya is very high, that's why proper seed germination and seedling growth are most important considerations in successful production under nursery technique of papaya cultivation. Plant vigour depends on seedling vigour. Hence attention has to be given from nursery stage itself in order to improve the seedling vigour. So increasing germination and producing vigorous seedling is very important for papaya nursery growers. Keeping in view above, the aims of the study was to identify suitable treatment combinations for better seed germination and seedling growth of papaya.

Material and Methods

The experiment was conducted at the Horticulture Research Farm, under Pt. Kishorilal Shukla College of Horticulture & Research Station, Rajnandgaon (C.G.). The experiment was framed out in factorial completely randomized design (FCRD), which included 28 treatments with 3 replications, there were two factors which comprised seven levels having equal ratios of different growing media viz. control; soil (M_0), soil: sand: FYM (M_1), soil: sand: vermicompost (M_2), soil: sand: rice husk (M_3), soil: sand: cocopeat (M_4), soil: sand: rice husk: vermicompost (M_5) and soil: sand: rice husk: cocopeat (M_6) and four levels of growth regulators viz. control; water (G_0), and GA_3 concentrations i.e. 100 ppm (G_1), 200 ppm (G_2) and 300 ppm (G_3). The seeds of papaya cv. Red Lady were soaked before sowing in the aqueous solution of GA_3 of the desired concentrations for 12 hrs in beaker. The seeds were dried for 10 minutes in shade after soaking. The dried seeds were immediately sown in the polythene bags at 1.2 cm depth. The polythene bags were watered by water cane.

The observations regarding germination were recorded during the germination period, and the germination percentage was calculated after the germination process was over. It was calculated by dividing the total number of seeds germinated by the total number of seeds sown and multiplying it by 100. The observation of growth parameters was recorded at different intervals, viz. 30, 45, 60, and 75 days after sowing, and the others were recorded at 75 DAS. The height of plant was measured by using meter scale and above 1 cm height of seedling.

$$\text{Germination Percentage} = \frac{\text{Total no. of seeds germinated}}{\text{Total no. of seeds sown}} \times 100$$

$$\text{Vigour Index} - \text{I} = \text{Germination \%} \times \text{Total length of seedling}$$

$$\text{Vigour Index} - \text{II} = \text{Germination \%} \times \text{Dry weight of seedling}$$

$$\text{Survival percentage} = \frac{\text{No. of survived seedlings}}{\text{Total no. of seedlings}} \times 100$$

Result & Discussion

Effect of Growing Media

Germination parameters

Among various growing medium, soil: sand: vermicompost; in 1:1:1 ratio (M_2), took the minimum time for germination (15.39 days), followed by soil: sand: rice husk: cocopeat; in 1:1:1:1 ratio (M_6), soil: sand: rice husk: vermicompost; 1:1:1:1 ratio (M_5) and soil: sand: cocopeat; 1:1:1 ratio (M_4), while the maximum time (17.00 days) was observed in control; soil (M_0). The higher germination percentage (97.50%) was noted in media M_2 followed by soil: sand: rice husk: vermicompost; 1:1:1:1 ratio (M_5), soil: sand: rice husk: cocopeat; in 1:1:1:1 ratio (M_6), and soil: sand: FYM; in 1:1:1 ratio (M_1). While the minimum germination percentage (83.33%) was recorded in control; soil (M_0). The most probable reason for minimizing the germination time and higher germination in the use of media soil: sand: vermicompost, 1:1:1 (M_2) is the presence of greater organic manures in this media, which contain organic acid with high accessible moisture and certain acids, which may increases the availability of nutrients and water holding capacity in media, which favor the germination. Similar findings were reported by Mishra *et al.* (2017) [12] in papaya and Parasana *et al.* (2014) [14] in mango.

Seedling parameters

The seedling parameters like height of seedling (18.11 cm), stem girth (7.43 mm) and no. of leaves (24.83) were found maximum in media soil: sand: rice husk: vermicompost; 1:1:1:1 (M_5). The higher plant height, stem girth and no. of leaves were observed in media containing vermicompost and rice husk because they included nutrients that improved nutritional status, pH levels, and organic carbon content. The worm casts increase the density of microbes, which also provide the required nutrients to plants and contain plant growth-promoting substances such as NAA, cytokinins, and gibberellins, which help in the development of plants. A similar result was obtained by Kaur (2017) [9] in mango and Gawankar *et al.* (2019) [7] in jackfruit.

Largest area of leaf (35.97 cm^2) was recorded in media soil: sand: FYM; in 1:1:1 ratio (M_1). The possible reason might be the fact that FYM contains sufficient nutritional content and creates conducive environment in terms of soil physical characteristics like aeration and porosity, allowing for improved root and shoot development, confirming similar results noted by Ramteke *et al.* (2015) [17] in papaya.

The fresh weight of seedling (10.96 g) and dry weight of seedling (2.78 g), vigour index-Ⅱ (160.77 g) and survival percentage (97.50%) were noted maximum in media soil: sand: vermicompost; in 1:1:1 ratio (M_2), similarly highest vigour index- I (4451.91 cm) was noted in M_2, which was statistically equal to soil: sand: rice husk: vermicompost; 1:1:1:1 ratio (M_5). A possible reason behind this might be that addition of vermicompost improves physical and biological conditions and maintain proper aeration and permeability, resulting in a good environment for plant growth and biomass. This result was in conformity of Prajapati *et al.* (2017) [15] in acid lime and Chaudhary *et al.* (2018) in papaya.

Whereas the minimum seedling height (7.51 cm), stem girth (3.99 mm), leaf area (14.17 cm^2), fresh weight of seedling (2.78 g), dry weight of seedling (0.54 g), length of root (20.68 cm), vigour index- I (2335.18 cm) and vigour index-Ⅱ (45.31 g) were noted in control; soil (M_0). The minimum no. of leaves (12.60) and survival percentage (69.63%) were noted in media soil: sand: cocopeat; 1:1:1 ratio (M_4).

Effect of GA_3

Germination parameters

Early germination (15.70 days) was recorded in seeds treated with 200 ppm GA_3 (G_2) followed by GA_3 100 ppm (G_1) and

GA_3 300 ppm (G_3). Similarly higher germination percentage (95.71%) was recorded in seeds treated with 200 ppm GA_3 (G_2) followed by G_3 and G_1. While the maximum time for germination (16.49 days) and minimum germination percentage (87.14%) were recorded in control; water (G_0).

The increased germination percentage in seeds treated with GA_3 200 ppm might be because of GA_3 involvement in activation of cytological enzymes and also increases cell wall plasticity and water absorption. This helps to loosen the seed coat and increases the germination. GA_3 is involved in two phases of germination: initial enzyme induction and activation of the reserve food mobilization mechanism, both of which boost germination. The mentioned result is in accordance with Lay *et al.* (2013) [11], Parab *et al.* (2017) [13], Chaudhary *et al.* (2018) and Rana *et al.* (2020) [18] in papaya.

Seedling parameters

In case of growth regulator GA_3 100 ppm (G_1) was found to be most effective for most of the seedling parameters like seedling height (12.46 cm), stem girth (5.71 mm), no. of leaves (18.22), leaf area (27.46 cm^2), fresh weight of seedling (7.69 g), dry weight of seedling (1.32 g), root length (30.25 cm), vigour index- Ⅰ (4005.03 cm), vigour index- Ⅱ (125.98 g). The maximum survival percentage (94.76%) was noted in G_1, which was at par with G_2 and G_3. While the minimum value of all seedling parameters were recorded in control water (G_0) viz. seedling height (10.66 cm), stem girth (5.16 mm), no. of leaves (16.39), leaf area (17.86 cm^2), fresh weight of seedling (4.65 g), dry weight of seedling (0.77 g), root length (22.44 cm), vigour index- Ⅰ (2909.78 cm), vigour index- Ⅱ (67.95 g), and survival percentage (82.22%).

The positive effect of GA_3 emphasised by the fact that the papaya seedling's endogenous levels of GA_3 were insufficient, and external treatment of GA_3 improved growth by promoting cell multiplication and cell elongation, leading to greater plant development GA_3 may have aided in the invigoration of plant physiological processes and the stimulatory action of chemicals to develop new leaves at a faster rate, resulting in an increase in the number of leaves. The influence of GA_3 on different plant parts leads to an increase in the fresh weight of shoots, which might be owing to its effect on promoting cell division, cellular and auxin metabolism, cell wall plasticity, and cell membrane permeability, all of which contribute to increased growth. A similar finding was reported by Ramteke *et al.* (2015) [17] and Hota *et al.* (2018) [8] in Jamun.

Effect of GA_3 and Growing Media

Germination parameters

Among different combinations of growing media and GA_3, the minimum time required for germination (13.98 days) was noted in soil: sand: vermicompost; 1:1:1 ratio with GA_3 300 ppm (M_2G_3). While the maximum time required for germination (18.43 days) was noted in soil: sand: rice husk; 1:1:1 ratio along with GA_3 100 ppm (M_3G_1). In the case of germination percentage the interaction between growing media and GA_3 was observed to be non-significant.

The reason behind minimum time required for papaya seed germination in sand: soil: vermicompost; 1:1:1 along with GA_3 300 ppm (M_2G_3) might be that vermicompost contains a high amount of organic matter, which provides the media with a sufficient amount of water and nutrients. It also contains bioactive principles which are beneficial for root growth, root initiation, germination and plant growth (Kaur, 2017) [9]. Gibberellic acid weakens the mechanical barriers of the endosperm cells and helps in radical protrusion. This facilitates the early germination. The results are in conformity with the findings of Desai *et al.* (2017) [6] in papaya.

Seedling parameters

The combination of the growing media and GA_3 resulted in a significant increase in seedling parameters. The greater values in respect to seedling height (21.85 cm), stem girth (8.16 mm), no. of leaves (28.13), fresh weight of seedling (14.79 g) and dry weight of seedling (2.09 g), were noted in soil: sand: rice husk: vermicompost; 1:1:1:1 ratio with GA_3 100 ppm (M_5G_1). M_5G_1 was statistically at par with M_5G_3 (soil: sand: rice husk: vermicompost; 1:1:1:1 ratio with GA_3 100 ppm) in case of stem girth, and in case of the dry weight of shoot it was statistically equal to M_1G_1 (soil: sand: FYM; 1:1:1 ratio with GA_3 100 ppm).

Increase in seedling parameters might be due to the combination containing many macro and micro nutrients, humic acid, which maintaining proper aeration and porosity and GA_3, which increases cell division and uptake of nutrients, thus increasing the growth of seedling. The increase in fresh weight and dry weight might be because the combination of GA_3 and media increases the water and nutrient transportation to aerial parts, which leads to production of photosynthetic product and translocation of various plant parts, resulting in a higher fresh and dry weight of shoot. Similar findings were obtained by Kumawat *et al.* (2014) [10] and Dayeswari *et al.* (2017) [5] in papaya.

Soil: sand: vermicompost; in 1:1:1 ratio with GA_3 100 ppm (M_2G_1) interaction recorded the maximum root length (37.49 cm), vigour index- Ⅰ (5441.17 cm) and vigour index- Ⅱ (223.26 g). In case of root length M_2G_1 was at par with M_3G_3, M_6G_1, M_3G_1, M_0G_1 and M_3G_2. The increased root growth is attributed to the fact that the combination of GA_3 and media provides a better root environment for the plant, resulting in better nutrient availability to the photo synthetically functional leaves and it also increases the translocation of food into the root zone, which leads to the production of root biomass. A similar result was recorded by Ramteke *et al.* (2015) [17] in papaya, Kaur (2017) [9] in mango, Parab *et al.* (2017) [13] in papaya.

The interaction of soil: sand: FYM; 1:1:1 ratio with GA_3 100 ppm (M_1G_1) was found to be superior in terms of leaf area (51.86 cm^2). The interaction of M_0G_3, M_2G_1, M_2G_2, M_2G_3, M_3G_1, M_3G_2, M_3G_3, M_5G_1 and M_5G_2 noted 100% survival percentage, which was statistically equal to M_1G_2, M_6G_3, M_6G_1, M_1G_3, M_1G_1, M_6G_2, M_6G_0, M_4G_1, M_2G_0, M_5G_0, M_5G_3 and M_0G_0.

Treatment combination of soil: sand: cocopeat; in 1:1:1 ratio with control; water (M_4G_0), recorded the minimum survival percentage (50%). The combination of control; soil with control; water (M_0G_0) noted minimum values in case of height (7.25 cm), stem girth (3.70 mm), no. of leaves (11.73), petiole length (3.30 cm), fresh weight of seedling (2.07 g), dry weight of seedling (0.44 g), vigour index-I (1913.72 cm) and vigour index- Ⅱ (33.96 g). The combination of soil: sand: rice husk; 1:1:1 ratio with control; water (M_3G_0) recorded minimum leaf area (8.90 cm^2). Root length (13.51) was noted as minimum in control (soil) with GA_3 300 ppm (M_0G_3).

Conclusion

According to the research findings, it may be concluded that among the different growing media, the minimum time for germination and maximum germination percentage were

noted in soil: sand: vermicompost; 1:1:1 ratio (M_2). Shoot growth parameters like seedling height, stem girth and no. of leaves were recorded maximum in M_5 and other parameters like fresh weight of seedling, dry weight of seedling, vigour index- Ⅰ, vigour index- Ⅱ and survival percentage were noted maximum in soil: sand: vermicompost; 1:1:1 ratio (M_2) media.

GA_3 had a positive effect shown in both germination and seedling parameters. GA_3 200 ppm was found to be the most appropriate for germination parameters; however, most of the growth parameters were improved by using GA_3 100 ppm.

The treatment combinations of soil: sand: vermicompost; in 1:1:1 ratio along with 100 ppm (M_2G_1) and soil: sand: rice husk: vermicompost; in 1:1:1:1 ratio with GA_3 100 ppm (M_5G_1) showed better results for seed germination, seedling growth parameters and survival percentage. Hence, it can be concluded that both the combination are good for seedling production.

Table 1: Effect of GA_3, growing media and their interaction on different germination and seedling parameters

	No. of days required for germination (DAS)	Germination percentage	Seedling height (cm)	Stem girth (mm)	No. of leaves	Leaf area (cm2)	Root length (cm)	Fresh weight of seedling (g)	Dry weight of seedling (g)	Vigour Index - Ⅰ (cm)	Vigour Index - Ⅱ (g)	Survival percentage
M0	17.00	83.33	7.51	3.99	12.75	14.17	20.68	2.78	0.54	2335.18	45.31	88.61
M1	16.44	94.17	15.73	6.93	23.65	35.97	25.76	8.91	1.46	3929.75	138.07	90.74
M2	15.39	97.50	15.98	6.91	23.30	31.32	29.51	10.96	1.65	4451.91	160.77	97.50
M3	16.99	88.33	8.40	4.02	12.88	14.48	32.40	3.63	0.72	3615.49	63.98	96.67
M4	15.81	93.33	7.58	4.29	12.60	14.19	22.40	2.94	0.62	2815.31	57.69	69.63
M5	15.50	96.67	18.11	7.43	24.83	29.57	26.34	10.50	1.23	4293.91	119.03	94.81
M6	15.48	95.00	7.90	4.55	13.58	14.51	27.74	3.07	0.72	3402.90	68.23	93.15
SE(m)	0.274	1.443	0.332	0.061	0.414	0.613	1.029	0.199	0.01	121.995	1.818	2.05
CD (p=0.05)	0.779	4.1	0.942	0.174	1.175	1.743	2.924	0.564	0.029	346.535	5.164	5.83
G0	16.49	87.14	10.66	5.16	16.39	17.86	22.44	4.65	0.77	2909.78	67.95	82.22
G1	16.27	93.33	12.46	5.71	18.22	27.46	30.25	7.69	1.32	4005.03	125.98	94.76
G2	15.70	95.71	11.54	5.36	17.99	21.22	26.53	5.97	0.93	3652.96	89.41	91.96
G3	15.89	94.29	11.73	5.55	18.03	21.59	26.39	6.14	0.94	3629.06	89.85	91.69
SE(m)	0.207	1.091	0.251	0.046	0.313	0.464	0.778	0.15	0.008	92.219	1.374	1.55
CD (p=0.05)	0.589	3.099	0.712	0.131	0.888	1.317	2.210	0.427	0.022	261.956	3.903	4.41
M0G0	17.15	76.67	7.25	3.70	11.73	10.01	17.71	2.07	0.44	1913.72	33.96	89.26
M0G1	17.04	80.00	7.33	4.25	12.07	18.56	32.51	2.68	0.56	3187.07	44.73	86.67
M0G2	16.89	90.00	7.75	3.93	13.73	12.91	19.01	2.50	0.48	2407.65	43.47	78.52
M0G3	16.92	86.67	7.69	4.06	13.47	15.21	13.51	3.86	0.68	1832.28	59.08	100.00
M1G0	17.64	86.67	14.81	6.72	22.73	29.96	18.74	6.65	1.02	2908.57	88.48	79.63
M1G1	15.04	93.33	16.23	7.19	23.93	51.86	25.89	12.24	2.04	3926.12	190.56	93.33
M1G2	16.46	100.00	16.49	7.10	24.07	31.06	29.59	7.95	1.17	4607.17	116.58	96.67
M1G3	16.64	96.67	15.39	6.71	23.87	31.01	28.84	8.80	1.62	4277.17	156.67	93.33
M2G0	15.75	93.33	14.33	6.57	21.80	24.11	24.34	8.99	1.35	3614.15	126.13	90.00
M2G1	16.29	100.00	16.93	7.15	24.00	40.46	37.49	12.73	2.23	5441.17	223.26	100.00
M2G2	15.52	96.67	16.29	6.96	23.87	27.81	24.84	11.72	1.78	3978.50	171.87	100.00
M2G3	13.98	100.00	16.35	6.97	23.53	32.91	31.39	10.41	1.22	4773.83	121.80	100.00
M3G0	17.46	83.33	7.76	3.79	12.13	8.90	28.59	2.39	0.49	3030.62	40.60	86.67
M3G1	18.43	93.33	9.05	4.20	12.93	19.40	33.34	5.27	1.01	3958.35	94.14	100.00
M3G2	15.61	86.67	7.89	3.82	12.80	11.50	32.34	3.33	0.62	3491.85	54.10	100.00
M3G3	16.47	90.00	8.90	4.26	13.67	18.10	35.34	3.53	0.75	3981.15	67.10	100.00
M4G0	16.63	86.67	7.26	4.30	11.87	14.13	17.75	2.69	0.61	2170.15	53.09	50.00
M4G1	16.14	93.33	7.85	4.50	13.00	14.15	22.05	3.05	0.62	2776.45	57.48	90.00
M4G2	14.73	100.00	7.91	3.95	13.40	14.32	24.25	3.33	0.62	3215.83	62.20	75.93
M4G3	15.73	93.33	7.31	4.41	12.12	14.15	25.55	2.69	0.62	3098.80	57.97	62.59
M5G0	15.46	93.33	15.24	6.76	21.20	24.01	27.34	6.87	0.75	3967.38	69.94	90.00
M5G1	15.48	96.67	21.85	8.16	28.13	33.31	25.34	14.79	2.09	4558.17	201.81	100.00
M5G2	15.30	96.67	16.39	7.01	23.80	35.86	27.84	9.90	1.09	4272.58	105.41	100.00
M5G3	15.76	100.00	18.94	7.77	26.20	25.11	24.84	10.42	0.99	4377.50	98.93	89.26
M6G0	15.36	90.00	7.99	4.27	13.27	13.90	22.66	2.89	0.70	2763.85	63.43	90.00
M6G1	15.46	96.67	7.99	4.50	13.47	14.46	35.13	3.04	0.72	4187.90	69.90	93.33
M6G2	15.36	100.00	8.09	4.78	14.27	15.08	27.88	3.06	0.72	3597.17	72.20	92.59
M6G3	15.73	93.33	7.51	4.66	13.33	14.61	25.31	3.28	0.72	3062.68	67.40	96.67
SE(m)	0.548	2.887	0.663	0.122	0.828	1.227	2.059	0.397	0.02	243.989	3.636	4.11
CD (p=0.05)	1.557	NS	1.884	0.347	2.351	3.485	5.848	1.128	0.057	693.07	10.327	11.66
CV%	1.967	5.39	3.302	1.298	2.706	3.215	4.502	11.263	3.52	11.91	6.75	2.63

References

1. Anonymous. Area and production of horticultural crops in India. Government of India Ministry of Agriculture & Farmers Welfare, 2019 a.
2. Anonymous. Area and production of horticultural crops in Chhattisgarh. Department of Agriculture, Directorate of Farm Forestry, Chhattisgarh, 2019 b.
3. Cheema GS, Dani PG. In. Fruits-Tropical and Subtropical, (Eds. Bose, T.K., Mitra, S.K. and Sanyal, D.), Naya Prakash 1990;1:507.

4. Choudhary RC, Kanwar J, Chouhan GS, Singh P, Tanwar DR. Effect of GA_3 and growing media on seedling growth of papaya (*Carica papaya* L.) cv. Pusa Nanha. International Journal of Chemical Studies 2018;6(6):1008-1012.
5. Dayeswari D, Rayaprolu S, Jone A. Effect of potting media on seed germination, seedling growth and vigour in TNAU Papaya Co.8 (*Carica papaya* L.). Int. J Pure App. Biosci 2017;5(3):505-512.
6. Desai A, Trivedi A, Panchal B, Desai V. Improvement of papaya seed germination by different growth regulator and growing media under net house condition. International Journal of Current Microbiology and Applied Sciences 2017;6(9):1-7.
7. Gawankar MS, Haldankar PM, Haldavanekar PC, Salvi BR, Jamadagni BM. Studies on seed germination and seedling growth in Jackfruit (*Artocarpus heterophyllus* Lam.) as influenced by media. International Journal of Chemical Studies 2019;7(5):1699-1705.
8. Hota SN, Karna AK, Jain PK, Dakhad B. Effect of gibberellic acid on germination, growth and survival of jamun (*Syzygium cumini* L. Skeels). The Pharma Innovation Journal 2018;7(8):323-326.
9. Kaur S. Effect of growing media mixtures on seed germination and seedling growth of different mango (*Mangifera indica* L.) cultivars under submountaineous conditions of Punjab. Chemical Science Review and Letters 2017;6(23):1599-1603.
10. Kumawat R, Maji S, Govind, Meena DC. Studies on seed germination and seedling growth of papaya (*Carica papaya* L.) cv. Coorg Honey Dew as influenced by media and chemicals. Journal of Crop and Weed 2014;10(2):281-286.
11. Lay, Padma, Basvaraju GV, Sarika G, Amrutha N. Effect of seed treatments to enhance seed quality of papaya (*Carica Papaya* L.) cv. Surya. Global Journal of Biology Agriculture & Health Science 2013;2(3):221-225.
12. Mishra U, Bahadur V, Prasad VM, Verty P, Singh AK, Mishra S *et al*. Influence of GA_3 and growing media on growth and seedling establishment of papaya (*Carica papaya* L.) cv. Pusa Nanha. International Journal of Current Microbiology and Applied Sciences 2017;6(11):415-422.
13. Parab, Arjun, Mathad JC, Malshe KV. Effect of pre-soaking chemicals on germination and subsequent seedling growth of papaya (*Carica papaya* L.) cv. Solo. International Journal of Chemical Studies 2017;5(4):1812-1816.
14. Parasana JS, Leua HN, Ray NR. Effect of mixture of growing Medias mixtures on germination and seedlings growth of mango (*Mangifera indica* L.) cultivars under net house conditions. The Bioscan 2014;8(3):897-900.
15. Prajapati DG, Satodiya BN, Desai AB, Nagar PK. Influence of storage period and growing media on seed germination and growth of acid lime seedlings (*Citrus aurantifolia* Swingle) cv. Kagzi. Journal of Pharmacology and Phytochemistry 2017;6(4):1641-1645.
16. Radha TK, Ganeshamurthy AN, Mitra D, Sharma K, Rupa TR, Selvakumar G. Feasibility of substituting cocopeat with rice husk and saw dust compost as a nursery medium for growing vegetable seedlings. The Bioscan 2018;13(2):659-663.
17. Ramteke V, Paithankar DH, Ningot EP, Kurrey VK. Effect of GA_3 and propagation media on germination, growth and vigour of papaya cv. Coorg Honey Dew. The Bioscan 2015;10(3):1011-1016.
18. Rana G, Deb P, Dowarah B, Sushmitha K. Effect of seed pre treatment on seed germination and seedling growth of papaya. Int. J Curr. Microbiol. App. Sci 2020;9(4):1066-1071.
19. Reyes MN, Perez A, Cuevas J. Detecting endogenous growth regulators on the sarcotesta, selerosta, endosperm and embryo by paper chromatography on fresh and old seeds of two papaya varieties. J Agric. Univ. Puerto Rico 1980;64(2):164-172.
20. Yahiro M. Effects of seed pre-treatments on the promotion of germination in papaya (*Carica papaya* L.). Memories of the Faculty of Agriculture. Kagoshima University 1979;15:49-54.