Journal of Science and Research Innovations

Volume - 2, Issue - 1, 2024, ISSN: 2583-9004 (ONLINE)

Effect of different chemicals on seed germination and vigour, growth of Papaya (*Carica papaya* L.) seedlings under polyhouse condition.

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ABSTRACT:
Experiment on effect of plant different chemicals on seed germination and vigour, growth of Papaya (*Carica papaya* L.) was carried out in poly house condition at the Instructional Farm of Department of Horticulture, College of Agriculture, Rewa (M.P.), under Randomized Block Design with thirteen treatments and replicated thrice. Seeds were treated with the aqueous solution of gibberellic acid (100 ppm, 200 ppm, 300 ppm), thiourea (1%, 2%, 3%) and KNO_3 (0.5%, 1%, 1.5 %) for each treatment. Among all treatments seeds soaked in GA_3 200 ppm recorded early germination (7.93 days), minimum days taken to complete germination (12.70 days), highest germination percentage (82.83), maximum plant height (7.17, 17.27 and 29.07 cm at 15, 30 and 45 DAS), maximum shoot diameter (2.05, 3.26 and 4.52 cm at 15, 30 and 45 DAS), maximum numbers of number of leaves per plant (2.33, 5.30 and 9.30 at 15, 30 and 45 DAS). Maximum fresh weight of leaves (gm), maximum dry weight of leaves (gm), maximum leaf area (cm2), maximum seedling vigour index, maximum shoots length (cm), fresh weight of roots (gm), maximum dry weight of roots (gm) (4.55, 0.55, 45.14, 1814.33, 22.07, 3.82 and 0.47, respectively) was also recorded with GA_3 200 ppm. Among the various treatments, GA3 200 ppm was superior to the other treatmentsfor the enhancement of germination traits.

KEYWORDS: Seed, Germination, RBD, Plant Height

Received: 18-01-2024 **Revised**: 25-02-2024 **Accepted**: 08-05-2024

INTRODUCTION:

Papaya is botanically known as *Carica papaya* L. belongs to the family Caricaceae and the genus Carica. Papaya is grown in all tropical and subtropical countries of the world covering 32' N and 32^0

S on the globe. It is mainly grown in Australia, Brazil, Columbia, Coasta Rica, Ecuador, Hawaii, India, Mexico, Nigeria, Malaysia, Philippines, Thailand, Venezuela, South Africa, Srilanka, Indonesia, Taiwan, Zaire, Cuba, Jamaica and Bangladesh.

In India papaya occupies 139 thousand hectares of area, which amount for the production of 6104 thousand MT. Andhra Pradesh is leading state in papaya production followed by Kerala, Gujarat, West Bengal, Chhattisgarh, Assam, Karnataka and Madhya Pradesh. (NHB,2018). Papaya is an important fruit of the tropical and subtropical regions of world and has been known as wonder fruit of the tropics. It gives higher production of fruits per hectare and income next to banana.

Papaya is propagated only through seeds as a viable option (Cheema and Dhani, 1990). The germination of papaya seeds is slow, erratic and incomplete (Chacko and Singh, 1966). The seed is enclosed within a gelatinous sarcotesta (aril or integument). This sarcotesta is reported to prevent germination. The slow and asynchronous germination is attributed due to presence of inhibitors (mainly phenolic compounds) in the sarcotesta and seed coats (Reyes *et al*. 1980).

Pre-sowing treatments with plant growth regulators and chemicals like Gibberellic Acid (GA_3), Thiourea, Potassium Nitrate (KNO_3), 1-Naphthalene Acetic acid etc. have a significant role on the germination percentage, emergence, seedling height, number of leaves and roots in papaya and other crops.

The role of GA_3 is to cause stem elongation and flowering of plants. It is also predominantly involved in mobilization of endosperm reserves during early embryo growth and seed germination (Shanmugavelu, 1985). Gibberellins act in the mobilization of seed reserves during the germination process. Therefore, they are considered important germination promoter and contribute to increased and uniform seed germination, thus improving the performance of papaya seeds (Zanotti and Barros, 2014).

In plants Thiourea has long been known for its dormancy breaking action (Denny *et al*, 1930) for potato tubers.

Germination of papaya seeds can be greatly improved by soaking them before planting in an aqueous solution of potassium nitrate (KNO_3). Germination percentage of both fresh and dried seeds can be increased with this method. The time to germination after the soaking treatment is reduced, and maximum germination is achieved sooner than when untreated seeds are planted.

A wide variety of pre sowing seed treatment, which includes the plant growth regulator and chemicals are used to enhance the seed germination and seedling growth in several fruit crops.

MATERIAL AND METHODS:

Experimental location

This study was taken up in poly house conditionduring August-September 2019 at the Instructional Farm,Department of Horticulture, College of Agriculture, Rewa, Jawaharlal Nehru Krishi Vishwa Vidyalaya Jabalpur, Madhya Pradesh, 482004, India.

Climate and weather conditions:

Seed germination trial was conducted in Rewa District, which is located in the North Eastern part of Madhya Pradesh, India at latitude 24º30' North latitude, 81º15' East longitude and 360.0 meters above mean sea level. Rewa has the subtropical climate with hot and dry summer and cold winters are the main characteristic feature of the region. In general, the maximum and minimum temperature goes above 43.3ºC and below 5 ºC respectively. The average rainfall varies from 900 mm to 1150 mm which is received mainly in rainy season (July-September).

Experiential Material

Seed:

F1 hybrid seeds of papaya cv. "Red Lady" were taken for the experiment. Cultivar red lady is a gynodioecious variety of papaya. It is a high yielding variety that can produce 50 to 120 fruits per plant each season. Fruits are medium sized (1-2kg) with orange red flesh. It starts yielding 10 months after planting and mainly grown as good table purpose variety.

Preparation of Chemical Solution

Preparation of GA3 solution: The solution of GA3 (100 ppm, 200 ppm and 300 ppm) was prepared by dissolving (10 mg, 20 mg and 30 mg) in 100 ml of distilled water in a beaker and stirred with glass rod, so that GA3 would thoroughly mix with distilled water.

Preparation of Thiourea solution:

Following steps were followed for the preparation Thiourea solution:-

a. Thiourea 1% - 1 gm of thiourea was taken and dissolved in 100 ml of distilled water in a beaker.
b. Thiourea 2% - 2 gm of thiourea was taken and dissolved in 100 ml of distilled water.
c. Thiourea 3% - 3 gm of thiourea was taken and dissolved in 100 ml of distilled water.

Preparation of KNO3 solution:

Following steps were followed for the preparation KNO3 solution:

a. KNO_3 0.5% - 0.5 gm of KNO_3 was taken and dissolved in 100 ml of distilled water.
b. KNO_3 1% - 1 gm of KNO_3 was taken and dissolved in 100 ml of distilled water.
c. KNO_3 1.5% - 1.5 gm of KNO_3 was taken and dissolved in 100 ml of distilled water.

Seed Treatments:

Seeds were treated with the aqueous solution of gibberellic acid, thiourea and KNO_3 for each treatment as per details of treatments given above.

Seeds Sowing:

All the untreated and treated seeds were sown in poly bags having a length of 20 cm and diameter of 30 cm with 200-gauge thickness containing vermicompost, FYM and soil in 1:1:2 ratios.

Sowing method:

Poly bags were filled with mixture of vermicompost and soil. One treated seed was sown in each poly bag and were irrigated immediately after sowing. Optimum moisture of germinating media was maintained during the period of seed germination.

After care:

Irrigation: Irrigation was done by the watering cane time to time. Nursery was kept partially moist for better germination and growth of the seedlings.

Weeding: Weeds were completely removed along with their roots as soon as they appear in the poly bags. The poly bags were kept clean by uprooting the weeds at weekly interval.

Observations under study:

Germination Studies:

Number of days taken to start germination: Seeds used for testing the germination were observed daily and recorded the data of initiation of germination of each treatment separately.

Number of days taken to complete germination: Total number of days was calculated from the date of sowing up to the end of germination.

Germination percentage: From the date of start germination, germinated seed were counted daily and finally the percentage of germination was calculated. The data were compiled successfully and germination percentage was calculated by the following formula.

$$\text{Germination } \% = \frac{\text{Total No. of germinated seed of a treatment}}{\text{Total No. of seed sown in the treatment}} \text{ X } 100$$

Shoot Observations:

Length of seedlings: Length of shoot or plant height was measured in cm after complete germination at 15 days interval with the help of meter scale in each treatment. The height of the seedlings of Papaya plant was taken from ground level to the base of the tip fully opened leaf.

Diameter of seedlings: The diameter of the stem of the seedlings was measured with the help of Vernier callipers just above the ground surface. It was measured in mm. after 15 days interval in each treatment.

Number of leaves per plant: The number of leaves of randomly selected plants was counted in 15 days interval in each treatment.

Fresh weight of leaves per plant: The fresh weight was taken from randomly selected plants from each treatment. The leaves were immediately weighed. The total leaves of a plant were put on a electrical balance. Weight of total leaves of per plant was recorded and mean fresh weight of leaves of a plant was calculated.

Dry weight of leaves per plant: The fresh weight of leaves was recorded and then the leaves were kept in oven to dry in appropriate temperature (60^0C) for 12 hours for the removal of moisture content from the leaves. The dry weight of leaves was recorded with the help of an electrical balance after dryness of leaves and average leaves weight per plant was calculated.

Seedling Vigour Index: The data were compiled successfully and S.V.I. was calculated by following formula.

S.V.I. = Total % of germinated seeds of treatment X Root length.

Leaf area (cm^2): For leaf area measurement, ten leaves were randomly selected in each treatment and average area of a leaf was measured in cm^2 with the help of leaf area meter.

Root observations:

Root length: The length of roots of randomly selected plants of each treatment was recorded with the help of meter scale. The length of roots was measured from the base up to tip.

Fresh weight of roots per seedling: Weight of detached roots from these selected plants was taken with the help of an electrical balance and average fresh weight per plant was calculated.

Dry weight of roots per plant: The roots of fresh weight were recorded and then the roots were kept in the oven to dry in the appropriate temperature (40^0C) for 12 hours for the removal of moisture content from the roots. The dry weight of roots was recorded with the help of an electrical balance after dryness of roots and average dry weight per plant was calculated.

Statistical analysis:

For judging the effect of different treatments, the data of different character were recorded and statistically analysed using the method of analysis of variance as described by R.A. Fisher (1954).

RESULTS AND DISCUSSION :

Germination parameters

Days taken to start germination

Days taken to start germination from 7.93 to 12.13 days (Table 1). The minimum number of days were taken for start germination was recorded in treatment T_3 GA_3 200ppm (7.93 days), which was at par with T_2GA_3 100ppm (8.23 days), $T_4GA_3$300ppm (8.57 days), T_5Thiourea 1% (9.27 days) andT_6Thiourea 2% (9.37 days) and superior to other treatments while the maximum number of days required to start germination was found in treatment T_1(without any treatment) (12.13 days).

Days taken to complete germination

The days taken to complete germination were significantly influenced by plant growth regulators and different chemicals (Table 1).The minimum days taken for complete germination was observed in T_3 GA3 200ppm (12.70 days) followed byT_2GA_3 100ppm (13.37 days) and T_4 GA_3 300ppm (13.90 days), while the maximum days taken for seed germination were recorded in T_1 (17.07 days).

Germination Percentage

Thegermination percentage of papaya seeds was influenced by various seed soaking treatments is presented in table 1.The highest percentage of seed germination (82.83%) was noticed in T_3 which is at par with T_9 (81.87%) and T_5 (79.99%) and superior to other treatments. Whereas, minimum germination percentage was recorded in control treatment T_1 (68.85%).

Table 1- Germination of papaya seeds as Influenced by different chemicals

Treatment Number	Treatments details	Days taken to start germination	Days taken to complete germination	Germination Percentage
T_1	Control	12.13	17.07	68.85
T_2	GA_3 100 ppm	8.23	13.37	75.55
T_3	GA_3 200 ppm	7.93	12.70	82.83
T_4	GA_3 300 ppm	8.57	13.90	75.53
T_5	Thiourea 1%	9.27	14.23	79.99
T_6	Thiourea 2%	9.37	14.77	73.30
T_7	Thiourea 3%	11.00	16.03	68.87
T_8	KNO_3 0.5%	10.17	15.37	69.07
T_9	KNO_3 1%	9.80	15.07	81.87
T_{10}	KNO_3 1.5%	12.03	16.50	71.07

	S.Em±	**0.56**	**0.52**	**2.16**
	C.D. at 5%	**1.63**	**1.53**	**6.31**

Shoot Observations:

Plant height (cm)

Afterpre-soaking treatment with GA_3, KNO_3 and Thiourea the plant of papaya seedlings was measured under polyhouse condition at 15, 30 and 45 DAS (Table 2). The seedling height was significantly influenced at every stage due to seed treatment with different concentration of PGR (GA_3) and chemicals (KNO_3 and Thiourea). The seed treated with thiourea at 1% encouraged the plant heightupto maximum extent at every stage of observations. The maximum plant height was in 7.23, 18.40 and 31.67 cm at 15, 30 and 45 DAS, respectively. This was closely followed by GA_3 200 ppm and KNO_3 1%. Thus, the seed treated with thiourea proved better than KNO_3 under each of the applied concentrations. The minimum value of plant height was found in control (5.93, 14.83 and 20.97 cm at the respective stages).

Diameter of shoot (mm)

The diameter of shoot of papaya seedlings was significantly influenced by use of different chemicals at 15, 30 and 45 DAS (Table 2). Themaximum diameter of shoot of papaya seedlings at 15, 30 and 45 DAS were recorded as2.05 mm, 3.26 mm and 4.52 mm, respectively in treatment T_3 (GA_3 200 ppm), Whereas, the minimum diameter of shoot was recorded with control (1.13, 1.97 and 3.11 mm at the respective stages).

Number of leaves per plant

The maximum number of leaves per plant was recorded with treatment T_5(Thiourea 1%) at 15 DAS (2.53), 30 DAS(5.63) and 45 DAS (9.53) and significantly superior. Whereas, the minimum number of leaves per plant was recorded undercontrol (T_1)at 15 DAS (1.33), 30 DAS(3.73) and 45 DAS(7.47)(Table 2).

Table 2- Plant height; shoot diameter and number of leaves of papaya seedlings at different growth intervals as influenced by different chemicals

Treatment Number	Treatments details	Plant height (cm)			Shoot diameter (mm)			Number of leaves per plant		
		15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
T_1	Control	5.93	14.83	20.97	1.13	1.97	3.11	1.33	3.73	7.47
T_2	GA_3 100 ppm	6.93	16.50	24.23	1.79	2.83	3.91	1.57	4.47	8.07
T_3	GA_3 200 ppm	7.17	17.27	29.07	2.05	3.26	4.52	2.33	5.30	9.30
T_4	GA_3 300 ppm	7.07	16.67	26.47	1.82	2.98	4.03	1.93	4.90	8.80
T_5	Thiourea 1%	7.23	18.40	31.67	1.95	3.10	4.28	2.53	5.63	9.53
T_6	Thiourea 2%	6.67	16.40	23.43	1.73	2.54	3.61	1.60	4.43	8.23
T_7	Thiourea 3%	6.37	16.33	23.00	1.44	2.35	3.41	1.47	4.00	7.77
T_8	KNO_3 0.5%	7.00	16.53	25.73	1.90	3.08	4.17	1.80	4.50	8.67
T_9	KNO_3 1%	7.10	16.77	28.07	1.34	2.24	3.35	2.00	5.17	9.03
T_{10}	KNO_3 1.5%	6.20	15.53	21.33	1.23	2.22	3.27	1.53	4.20	7.97
	S.Em±	**0.19**	**0.45**	**1.26**	**0.11**	**0.17**	**0.20**	**0.22**	**0.24**	**0.25**
	C.D. at 5%	**0.58**	**1.33**	**3.69**	**0.34**	**0.52**	**0.60**	**0.66**	**0.72**	**0.75**

Fresh and dry weight of leaves (gm)

The fresh weight and dry weight of leaves was significantly influenced by use of different chemicals at 45 DAS of papaya seedlings**(Table 3).** Treatment T_3 (GA_3 200 ppm) recorded the maximum fresh and dry weight of leaves of papaya seedling (4.55 gm and 0.55 gm, respectively) which is followed by T_5 (4.34 gm and 0.52 gm, respectively) and T_9 (3.39 gm and 0.51, respectively) while it was found minimum in treatment T_1 (1.16 gm and 0.14 gm, respectively) i.e. control.

Leaf area (cm^2)

Observations on the leaf area was recorded the maximum in T_3 (45.14 cm^2) which is at par with T_2 (43.62 cm^2), T_9 (41.79 cm^2), T_4 (38.05 cm^2) and T_6 (37.34 cm^2) while it was found minimum in treatment T_1 (25.33 cm^2) i.e. control**(Table 3).**

Seedling vigour index

Seedling vigour index (SVI) was calculated as per prescribed formula under each treatment. The data highlighted **(Table 3) and** indicate that the highest SVI was found in T_3 (1814.33) as compare

to the remaining treatments. However, the second-best treatment was T_4 having (1460.30) whereas, lowest SVI (819.14) was noticed under the control (T_1) treatment having only seed soaked with distilled water.

Length of roots (cm)

The length of roots of papaya seedlings was found maximum in treatment T_3 (22.07 cm) which is at par with T_4 (19.33 cm), while the minimum length of root was recorded in control T_1 (11.91 cm)**(Table 3).**

Fresh and dry weight of roots (gm)

Fresh and dry weight of roots of papaya seedlings were noted ant revealed that the fresh weight and dry weight of roots was recorded maximum in treatment T_3 (3.82 gm and 0.47 gm, respectively) which is followed T_9 (3.47 gm and 0.42 gm, respectively) and T_8 (3.37 gm and 0.36, respectively) while it was found minimum in treatment T_1 (1.24 gm and 0.11 gm, respectively) i.e. control**(Table 3).**

Table 3- Number of leaves per plant of papaya as influenced by different chemicals

Treatment Number	Treatments details	Fresh weight of leaves (gm)	Dry weight of leaves (gm)	Leaf area (cm^2)	Seedling vigour index	Roots length	Fresh weight of roots (gm)	Dry weight of roots (gm)
T_1	Control	1.16	0.14	25.33	819.14	11.91	1.24	0.11
T_2	GA_3 100 ppm	2.61	0.48	43.62	1412.06	18.69	2.93	0.32
T_3	GA_3 200 ppm	4.55	0.55	45.14	1814.33	22.07	3.82	0.47
T_4	GA_3 300 ppm	2.91	0.46	38.05	1460.30	19.33	2.72	0.31
T_5	Thiourea 1%	4.34	0.52	31.83	1226.28	15.33	2.40	0.26
T_6	Thiourea 2%	2.21	0.4	37.34	1136.15	15.50	1.88	0.21
T_7	Thiourea 3%	1.54	0.29	30.1	1260.70	18.31	1.37	0.17
T_8	KNO_3 0.5%	1.81	0.33	33.2	1131.22	16.31	3.27	0.36

T_9	KNO_3 1%	3.39	0.51	41.79	1434.52	17.45	3.47	0.42
T_{10}	KNO_3 1.5%	1.35	0.25	27.61	1032.56	14.53	2.20	0.23
	S.Em±	**0.5**	**0.05**	**2.92**	**106.48**	1.02	0.35	0.04
	C.D. at 5%	**1.47**	**0.15**	**8.52**	**310.80**	2.99	1.04	0.12

Germination parameters

The data in table 4.1 revealed that the minimum number of days was taken to start germination in T_3 having GA_3 200 ppm (7.93 days). It was the ultimate beneficial impact of this treatment. On the other hand, the corresponding values in case of untreated check T_1 (12.13) days was taken maximum period to start germination. The same treatments T_3 eventually brought about complete germination in earliest time in 12.70 days and maximum days for completion of germination required in treatment T_1 (17.07 days). However, the germination percentage was also maximum in treatment T_3 (82.83%) and minimum seed germination was observed in T_1 (68.85%). These results were attained due to GA_3 having stimulatory effect in the formation of enzymes which are important in the early phase of germination which helps for faster radicle protrusion. Faster protrusion of radicle has given higher rate of germination for GA_3 at 200 ppm as compared to control. Chacko and Singh (1966) also reported higher rate of germination of papaya seeds treated with GA_3. These results are in conformity with the findings of Babu *et al*. (2010) and Anjanawe*et al*. (2013) in papaya. The endogenous Gibberellic acid synthesized by the seed embryo might not be sufficient and as such the external application might have boosted the growth by increasing cell multiplication and cell elongation, resulting in rapid plant growth. The rapid and early germination might have helped in producing vigorous growth of seedlings during subsequent period of growth. The results are in conformity with the finding of Zhao *et al.* (2004) in papaya and Maiti*et al.* (2003) in jackfruit.

Growth of seedlings

The growth parameters of papaya as affected by pre-soaking chemicals are presented in Table (2 and 3). The plant height is one of the important characters in growth and development of seedling. At 45 DAS seeds treated with thiourea at 1% recorded highest height (31.67 cm) as compared to control which had recorded the lowest (20.97 cm). Similar findings were made by Parab*et al.* (2016) and

Anitha*et al*. (2004) in cowpea. From the physiological point of view, leaf is the most important photosynthetic site of the plant. It is the source from which the plant derives energy for its metabolic activities. The primary function of leaves is the carbon assimilation. Regarding the number of leaves, at 45 DAS it was recorded highest in seeds treated with thiourea at 1% (9.53) which was on par with seeds treated with GA_3 at 200 ppm (9.30) and least was recorded in control (7.47). Similar results were obtained by Anjanawe*et al*. (2013) for seeds of papaya treated with 200 ppm of GA_3. The favourable effect of thiourea on plant growth might be due to improved photosynthetic efficiency. Thiourea is a sulphydral compound which plays a bio-regulatory role in plants due to presence of SH-group and stimulated the photosynthetic CO_2 fixation mechanism. The SH-group has diverse biological activities such as diversion of photosynthates from source to sink (Meena *et al*, 2014). Similar findings also reported by Balai and Keshwa (2011) and Sanu *et al*. (2013) in coriander.

The diameter of shoot of papaya seedling was augmented upto maximum extent when pre-sowing seeds were treated with 200 ppm of GA_3 at 15,30 and 45 days after sowing. The maximum shoot diameter was 2.05, 3.26 and 4.52 mm and minimum were found in control (1.13,1.97 and 3.11 mm) at the above-mentioned respective intervals. The maximum diameter of stem in case of seedlings obtained from GA_3 pre-soaked seeds might be due to the fact that GA_3 application enhanced the rate of cell division and elongation of stem portion. Increase in stem diameter may be possible due to stimulation of cambium and its immediate cell progeny as observed by Dhankhar and Singh (1996) in aonla. Regarding to leaf area, it was recorded highest in seeds treated with GA_3 at 200 ppm (45.14 cm^2) as compared to control (25.33 cm^2). Similarly, the fresh and dry weight of leaves were found maximum in seeds treated with GA_3 at 200 ppm (4.55 g and 0.55 g, respectively) and minimum in control (1.16 g and 0.14 g, respectively). The application of GA_3 might have boosted the leaf growth by increasing cell multiplication and cell elongation resulting in better leaf area. Similar results of increased leaf area with GA_3 pre-sowing treatment were reported by Anjanawe*et al*. (2013).

Root growth of seedlings

In length of root of papaya seedling, seeds treated with GA_3 at 200 ppm recorded the highest (22.07 cm) root length as compared to control (11.91 cm). The maximum root length might be due to elongation of the cells in the sub-apical region of roots as reported by Salisbury and Ross (1988). Similarly, the highest fresh weight of roots (3.82 g) was recorded in GA_3 treated seeds at 200 ppm

followed by KNO_3 treated seeds at 1% (3.47 g) as compared to control (1.24 g). This might be because of higher mobilization of water, nutrient uptake capacity and its transportation by gibberellin than cytokinin which has resulted into more production of photosynthetic products and translocation into various parts of the plant. The result is in conformity with the findings of Dhankhar and Singh (1996) in aonla and Meena and Jain (2012) in papaya. Similarly, because of the more accumulation of photosynthetic products dry weight of root was recorded maximum in GA_3 at 200 ppm. Similar results were obtained by Vasantha*etal*. (2014) in tamarind.

The seedling vigour index (SVI) which was obtained by multiplying the % seed germination with the root length was encouraged maximum due to seed treated with GA_3 at 200 ppm in T_3 (1814.33). The second-best treatment was T_4 having GA_3 at 300 ppm (1460.30) and found lowest in control (819.14). The seedlings that emerged early are vigorous. Since the germination percentage and root length were found highest in GA_3 treatments hence this would be the reason for higher vigour index of seedlings of papaya. These facts agree with the findings of Anburani and Shakila (2010).

CONCLUSION:

In the present investigation findings reveal that, seed germination and growth parameter were significantly influenced bypre-soaking of seeds with T_3 i.e. GA_3 at 200 ppm had significant effect on maximum parameters of seed germination, vigour and growth of papaya seedlings under polyhouse condition, as compared to other treatment. While treatment T_5 Thiourea @1% had significant influence on height of seedling and number of leaves as compared to other treatments.

While looking to the economics of the treatment imparted, in present investigation, the treatment T_9 i.e. KNO_3 @1% gives maximum profit and benefit cost ratio (1:1.66).

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Journal of Science and Research Innovations

Volume - 2, Issue - 1, 2024, ISSN: 2583-9004 (ONLINE)