Influence of potting media and GA_3 on seed germination and seedling growth of Guava (*Psidium guajava*) cv. Allahabad safeda under shade net condition

Comment [AC1]: The title needs to be adjusted, so that it can be more attractive and technical: Effects on the germination and development of seedlings of*Psidium guajava* cv. Allahabad safeda in.... include the site where study was done.

ABSTRACT

The results of present investigation revealed that among the different potting media treatments, M_1: Vermiculite + Garden soil + Sand was found to be most beneficial for improving took days to germination, germination percentage, height of the seedling, number of leaves seedling-1, stem diameter, primary roots length (cm), number of secondary roots, fresh and dry shoots weight, fresh and dry roots weight, seed vigor index –I and II and leaf area (cm). In present investigation, application of G4: $GA_3$600 ppm significantly enhanced the seed germination and seedling growth viz., germination, germination percentage, height of the seedling, number of leaves seedling-1, stem diameter, primary roots length (cm), number of secondary roots, fresh and dry shoots weight, fresh and dry roots weight, seed vigour index –I and II and leaf area (cm).The effect of interaction of different level of GA_3 (0.00, 400, 500 and 600ppm) and different level of potting media viz., vermicuilite, garden soil, sand, FYM, cocopeat and vermicompost (1:1:1 ratio) on seed vigour index-I. The maximum seed germination, days to germination, and seedling growth, seed vigour index I & II and leaf area was found in treatment GA_3 600 PPM+ Vermiculite + Garden soil + Sand. The effect of interaction of GA_3 and potting media was found significant for seed germination, days to germination, and seedling growth, seed vigour index I & II and ~~leaf area~~leaf area of guava cv. Allahabad safeda seedling under shade net condition.

Comment [AC2]: In the abstract they only present results, they do not include important aspects such as: Definition of the problem, justification, objectives, methodologies (Experimental design, variables, statistical analysis, location), the most important results and the conclusions where the impact of the results is shown. biological and agronomic results.

Key words: - Potting media, GA_3, seed germination, seedling growth, Guava Allahabad safeda

Comment [AC3]: These are not good keywords, consult the international thesauri for a better selection of them.

INTRODUCTION

Seed propagation is necessary for raising rootstocks for grafting and budding practices. Graft success and vigour of graft largely depends on quality of rootstock. Huge variability in growth pattern of seedling plantation has been reported in guava **(Shashikumar, 2010).** There is a need to identify a suitable rootstock with good vigour and wider adoptability (**Praveen *et al.*(2017).** Seeds of guavas for industrial purposes are generally considered a waste product. Their use in propagation is restricted to breeding programs or rootstock production for grafting of scion cultivars.

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However, in countries that do not use high technology, guava is still propagated by seed, without grafting. Plants that are produced by seed are referred to as seedlings, which is the simplest propagation method of guava trees. It is an undesirable feature in commercial orchards, as it causes low productivity and fruit quality **(Pereira, 1990)**. In addition, seedlings have a higher juvenility period, delaying entry into production, because they need between two and four years to bloom. Vegetative propagation In Florida, until 1948, 160 ha of guava crops were grown, and all trees were obtained from seed (**Kuperberg, 1953**). With the emergence of more productive cultivars and the need to perpetuate their characteristics, studies on vegetative propagation were carried out in

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California using roots cuttings **(Webber, 1944)** and in Florida using layering (**Ruehle, 1948),** herbaceous cuttings from shoots under intermittent mist system (**Kuperberg, 1953**) and grafting (**Nelson, 1954**). Different methods such as water soaking, scarification, and chemical treatment are used to break seed dormancy and to stimulate germination and seedling growth (**Brijwal and Kumar 2013**; **Dawood 2018**). Acid scarification of seeds helps to break seed dormancy and improves germination (**Essien 2004**; **Maldonado-Arciniegas *et al.* 2018**)Germination is strongly affected by environmental conditions including temperature, water availability, light, etc. (**He *et al.*2013**; **Humphries *et al.* 2018**). Imbibition of water is the first step in the germination process. Any deficiency of water during germination strongly limits seed germination (**Cavallaro *et al.* 2014**; **Lamichhane *et al.* 2018**). Gibberellin is a very potent hormone whose natural occurrence in plants controls their development. Gibberellins are in the third place with 17 % share among the most commonly used herbal hormones within the natural plant growth regulators. It regulates growth; application of very low concentrations can have profound effect. GA3 is the most commonly used Gibberellin; it has number of effects on plant growth and development **Singh *et al.* (2022)**. It can stimulate rapid stem and roots growth, induce mitotic division in the leaves of some plants and increase seed germination rates. Gibberellins are known to influence both cell division and cell enlargement **(Adams *et al.* 1975).**

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Comment [AC4]: The introduction does not have a definition of the problem, it should be better organized starting with the generalities of the species, its economic importance at an international, national and regional level, as well as its different uses. Antecedent studies interrelated with this research are not presented, only outdated studies and a lot of uncorrelated information are mentioned. Authors are suggested to consult literature from no more than five years ago, include them considering the species where they were made (if it is not in guava, it can be in related species or fruit trees) and also the region or country, give context to the results. background. The introduction should end with the objective and impact of the research.

MATERIALS AND METHODS

The present investigation entitled **"Influence of potting media and GA_3 on seed germination and seedling growth of Guava (*Psidium guajava*) cv. Allahabad safeda under shade net condition"**was carried out during rainy season in the year 2022at Horticulture Research Farm, Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). Seeds were sown in the poly bag (9x12 inch sized) at Horticulture Research Farm SHUATS, Prayagraj under shade net condition. For study, a total 500 seeds of guava were sown on 23rd July 2022. The experiment comprised of different concentration of GA_3 water soaking *viz.*, GA_3 0.00 ppm, GA_3 400 ppm, GA_3 500 ppm and GA_3 600 ppm and four different growing media vermiculite, garden soil , fym, cocopeat vermicompost having 16 treatment combinations. The experiment was laid out in poly bags in factorial randomized block design (4x4) with three replications. Observations were recorded using standard procedure and statistically analysed. The mean value of data was subjected to analysis of variance as described by **Panse and Sukhatme (2000).**

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Comment [AC5]: The methodology should be written in a more technical way.

Comment [AC6]: They must describe the agroclimatological characteristics of the area where the study was carried out. Include the parameters that were taken into account for the selection of the variety. The treatments are presented in a table, in addition to including the experimental units and the selection criteria of the concentrations of gibberellic acid. The statistical analysis of the information and the program used are not mentioned. Include the bibliographical references that support the methodological procedures.

Observations recorded:

The following observations were recorded during the experimental period. The observations pertaining to germination and vegetative growth ~~characters were~~characters were recorded at 60 days interval for a total period of 240 days after application of treatments.

Days required for initiation of germination:

In each treatment the day on which first germination of seed was initiated from the date of sowing considered as days required for initiation of germination. The number of days required for initiation of germination was calculated.

Germination percentage:

After completion of entire germination, the percentage of germination was calculated. The germinated seeds in each treatment were counted at an interval of two days and after completion of germination, the total numbers of germinated seeds were subtracted from total number of seeds sown and percentage of germination was calculated.

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total Number of seeds put for germination}} \times 100$$

Growth Attributes:

Height of seedling (cm):

Height of the stem was measured from base to growing tip of the main stem in centimeter. A meter scale was used for this purpose. It was measured for all the five plants which were tagged and later on averaged.

Number of leaves per seedling:

The total number of fully grown leaves was counted of all the five tagged plants and average was calculated.

Stem diameter (cm):

Initial diameter of stem of tagged five plants was measured separately with the help of digital vernier caliper at 30 day of sowing the seed. Thereafter, periodical observations of diameter of stem were measured at 15 days interval for a total period of 45 days.

Primary roots length (cm)

Length of tap roots was computed using a measuring tape after uprooting guava ~~seedling .~~seedling.

No. of secondary roots

The number of secondary roots was manually counted and averaged for five guava seedlings.

Fresh weight of seedling (g):

All the five tagged plants are selected in each treatment and fresh weight was measured by electronic balance and average weight was calculated.

Dry weight of seedling (g):

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The seedlings which were selected for fresh weight were dried in oven at 60°C for 48 hours. After drying, the dry weight of seedling was measured by electronic balance and average weight calculated.

Dry weight of roots (g):

The seedlings which were selected for fresh weight were dried in oven at 60°C for 48 hours. After drying, roots separated from the seedling and dry weight of roots was measured by electronic balance and average weight calculated.

Dry weight of shoots (g):

The dry weight of shoots was calculated by subtracting dry weight of roots from dry weight of seedling.

Seedling vigour index I

Seedling vigour index I was calculated by adopting the method suggested by **Abdul-Baki and Anderson (1973)**

Seedling vigour index I = Germination (%) x total seedling length (cm).

Seedling vigour index II:

It was computed by adopting the formula as suggested by **Abdul-Baki and Anderson (1973)** and expressed in whole number:

Seedling vigour index-II = Germination (%) x seedling dry weight (g)

RESULTS AND DISCUSSION

The data pertaining to effect of different level of GA_3 (0.00, 400, 500 and 600ppm) on **seed germination and seedling growth** of guava cv. Allahabad safeda seedling under shade net condition are presented in table 1. The result for the **seed germination and seedling growth** showed significant different for the various treatment. However the maximum days to germination (26.25) was recorded for the treatment G4: GA_3 600 ppm. Whereas the minimum days to germination 44.76 was found in treatment G1: GA_3 0.00ppm. The result for the seed germination and seedling growth parameters of guava seedling (~~*Psidiu*~~*Psidium guajava*) cv Allahabad safeda under shade net condition showed significant different for the various treatment. However the maximum germination (%) (89.40), height of the seedling (cm) (30.078), number of leaves seedling^{-1} (15.17), stem diameter (cm) (3.28), primary roots length (cm) (7.35), number of secondary roots (20.26), fresh weight of shoots (g) (16.26), dry weight of shoots (g) (6.26), fresh weight of root (g) (1.93), dry weight of roots (g) (1.11), seed vigour index-I (2691.29), seed vigour index- II (658.80) and leaf area (cm) (62.18) was recorded for the treatment G_4: GA_3 600 ppm. GA_3 enhanced seed germination, which might have antagonized the effect of inhibitors present in anloa seeds (**Kumari *et al.* 2007**). Similar results were also reported by **Suryakanth*et al.* (2005)** and **Singh and Soni,** (1974) and **Singh, (1967)** that guava seeds have hard seed coat resulting in delayed germination.

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Hayes, (1953~~) reported~~**)** reported that acid scarification of guava seeds shortened the germination period without adverse effect on germination percentage. The increase in germination percentage with GA_3 might be due to involvement of GA_3 in the activation of cytological enzymes along with increase in cell wall plasticity and better absorption of solvents **(Padma lay *et al.* 2013).** GA_3 treatment would have stimulated germination, due to increase in relative growth rate. **(Powell 1990)**~~.~~

Reported that decreased germination percentage at higher water temperature could be attributed to embryo damage.

Teketay (1998) reported lower availability of O2 with higher water temperature which resulted in destruction of certain enzymatic component leading to poor germination percentage. Increased seedling length in GA_3treated seedlings might be due to the stimulating effect on cell wall to release and transmit its calcium into cytoplasm that provides a condition for absorption of water by increase in cell size and growth.

Aatla and Srihari, (2013)reported that treatment of mango cv. Alphonso kernel with GA_3 500 ppm resulted in greater seedling height and internodal length. Increased shootslength with GA_3 treatment 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 **(Vishwakarma, 2013).**

Comment [AC7]: Comparative studies are very outdated.

GA_3 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 GA_3 may be attributed to increase the physiological process and stimulatory action of GA_3 to form new leaves at faster rate. **Archana et al., (2015**~~) reported~~**)** reported similar results in *Annona squasmosa*, **Ramchandra and Govind, (1990)** in guava and **Dinesh and Padmapriya (2022).** The maximum stem girth of seedling obtained from GA_3 treated seeds might be due to the fact that GA_3 treatment enhancedthe rate of cell division and cell elongation of stem portion. **Reshmi*et al.*, (2007)** reported similar results of GA_3 pre-soaking treatment to increase the stem girth in aonla**Dinesh and Padmapriya (2022)** in guava.

Comment [AC8]: Expand the discussion towards the agronomic implications of the results.

Similar results of increased roots growth with GA_3 pre sowing treatment was reported by Pampanna and **Sulikeri (2001)** in sapota cv. Kalipatti. The maximum roots length in case of seedling obtained from GA_3 pre-soaked seeds might due to increase the elongation of the cells in the sub apical region of the rootss as reported by **Salisbury and Ross, (1988)** and **Dinesh and Padmapriya (2022)** in guava. This might be due to proper level of gibberellic acid which might be resulted in rapid cell division, elongation and multiplication process in seedlings that has reflected increase in primary roots length and increasing number of secondary rootss. Similar results are in agreement with the findings of **Pampanna and Sulikeri (2001)** in sapota and **Kumawat*et al.* (2014)** in papaya and **Borich*aet al.*, (2020).** The results are in close conformity with the findings of **Patil*et al.* (2012) in citrus; Patil*et al.* (2018)** in jamun;**Vasanth*aet al.* (2014) and Tandon*et al.* (2019)** in tamarind**.** The above results are in harmony with those of **Mohamed *et al.* (2010)** who found that foliar spraying of Sour orange and Volkamer lemon rootstocks with GA_3 at 200 and 400 ppm significantly increased stem length and diameter and leaf area in comparison with untreated seedlings. Whereas the minimum germination (72.18%) germination (72.18%), height of the seedling (cm) (26.09), number of leaves

seedling^{-1} (12.35), stem diameter (cm) (1.54), minimum primary roots length (cm) (5.28), number of secondary roots (16.39), fresh weight of shoots (g) (9.62), dry weight of shoots (g) (3.28), fresh weight of root (g) (1.30), dry weight of roots (g) (0.27), seed vigour index-I (1886.47), seed vigour index- II (256.88) and leaf area (cm) (36.01) was found in treatment G1: GA_3 0.00ppm.

The data pertaining to effect of different level of potting media viz., vermiculite, garden soil, sand, FYM, cocopeat and vermicompost (1:1:1 ratio) on seed germination and seedling growth of guava cv. Allahabad safeda seedling under shade net condition are presented in table 1. ~~The result~~The result for ~~the days~~the days to germination showed significant different for the various treatment. However ~~the maximum~~the maximum days to germination (32.11) was recorded for the treatment M1: Vermiculite+ Garden Soil + Sand (1:1:1). ~~Where as~~Whereas~~the minimum~~the minimum days to germination 36.38 was found in treatment M3: Cocopeat + Garden Soil + Sand (1:1:1). ~~The result~~The result for the seed germination and seedling growth showed significant different for the various treatment. However the maximum germination (%) (91.52), height of the seedling (cm) (30.71), number of leaves seedling^{-1} (17.04), stem diameter (cm) (2.61), primary roots length (cm) (6.43), number of secondary roots (18.97), fresh weight of shoots (g) (14.79), dry weight of shoots (g) (5.19), fresh weight of shoots (g) (1.69), dry weight of roots (g) (0.78), seed vigour index-I (2551.58), seed vigour index- II (502.70) and leaf area (cm) (53.20) was recorded for the treatment M1: Vermiculite+ Garden Soil + Sand (1:1:1). ~~Where as~~Whereas the minimum germination (%) (70.01), height of the seedling (cm) (25.67), height of the seedling (cm) (25.67), number of leaves seedling^{-1} (10.79), stem diameter (cm) (2.13), primary roots length (cm) (6.02), number of secondary roots (18.27), fresh weight of shoots (g) (12.65), dry weight of shoots (g) (4.51), fresh weight of root (g) (1.56), dry weight of roots (g) (0.60), seed vigour index-I (2032.17), seed vigour index- II (411.47) and leaf area (cm) (47.21) was found in treatment M3: Cocopeat + Garden Soil + Sand (1:1:1). . Vermicompost is reported to have bioactive principles which are considered to be beneficial for root growth and this has been hypothesized to result in greater root initiation, higher germination, increased biomass, enhanced growth and development **(Bachman and Metzger, 2008)** and also balanced composition of nutrients **(Zaller, 2007).** This result is akin to the findings of **Campos Mota et al. (2009) and Abirami et al. (2010)** who suggested that since coir dust is low in nutrients when mixed with vermicompost, provides a better growth medium for plant establishment.

The effect of interaction of different level ~~of GA~~of GA_3 (0.00, 400, 500 and 600ppm) and different level of potting media viz., vermiculite, garden soil, sand, FYM, cocopeat and vermicompost (1:1:1 ratio) on germination and seedling growth parameter of guava. The minimum days to germination (25.12 days) was found in treatment T13 G4: 600 ppm+ M1: Vermiculite + Garden soil + Sand. ~~Where as~~Whereas the maximum days to germination (48.49) was recorded in treatment G1: 0.00 ppm+ M3: Cocopeat+ Garden soil + Sand. The maximum germination percentage (91.52), height of the seedling (32.78), number of leaves seedling-1 (18.61), stem diameter (3.53), primary roots length (cm) (7.59), number of secondary roots (21.68), fresh and dry shoots weight (16.71 &6.51), fresh and dry roots weight (1.93 & 1.31), seed vigour index –I and II (3000.11 & 699.87) and leaf area (cm) (66.33) was found in treatment T13 G4: 600 ppm+ M1: Vermiculite + Garden soil + Sand. ~~Where as~~Whereas the minimum

Comment [AC10]: The discussion continues to be very general and does not consider agronomic aspects and practical implications that would really give it its impact.

germination percentage (70.01), height of the seedling (2.53, 10.19, 15.44 and 22.49), number of leaves seedling-1 (9.21), stem diameter (1.28), primary roots length (cm) (5.06), number of secondary roots (16.99), fresh and dry shoots weight(17.98 & 2.70), fresh and dry roots weight(1.22 and 0.16), seed vigour index –I and II (1574.43 and 200.57) and leaf area cm^2 (32.23) was recorded in treatment G1: 0.00 ppm+ M3: Cocopeat+ Garden soil + Sand. Cocopeat and peatmoss which are rich in coconut waste and other biodegradable material enhance the soil fertility and nutrients available for overall seedling production (Raja et al., 2018). It also provides desirable vegetative growth and increases the number of leaves and leaf area **(Aslanpour et al., 2018).** It might be due to the successful use of lightweight growing media, cocopeat and peatmoss maintains sufficient aeration for the root zone it has air pockets or pores to supply oxygen to plant roots and allow for drainage. Oxygen plays a critical role in determining root orientation as well as root metabolic status. Similar results were obtained by **Arvind et al. (2015), Ramteke et al. (2015), Rakibuzzaman et al. (2019) and Nandini and Singh (2021)** in papaya.

Comment [AC11]: Take into account the recommendations made in this entire item.

CONCLUSION

It is concluded that treatment T13 G4: 600 ppm+ M1: Vermiculite + Garden soil + Sand recorded minimum days to germinations (25.12), maximum days to germinations (91.52), height of the seedling (cm) (32.78), number of leaves seedling-1 (18.61), stem diameter (3.53cm), primary roots length (7.59cm) , number of secondary roots (21.68), fresh weight of shoots (16.71g) , dry weight of shoots (6.51g), fresh weight of roots (1.93g), dry weight of roots (1.31g) , seed vigour index-I (3000.11), seed vigour index-ii (699.87), leaf area (66.33cm^2).

Comment [AC12]: The conclusions should not be a summary of the main results found, but show the impact at a biological and agronomic level that they have.

REFERENCES

Aaltla HB, Srihari D. Influence of pre-sowing treatments on germination, Growth and vigour of mango cv. Alphonso. Asian J Hort. 2013; 8(1):122-125.

Abdul-baki, A. and Anderson, JD (1973). Vigour determination in soybean seed by multiple criteria. Crop Sci 13: 630-633.

Abirami K, Rema J, Mathew PA, Srinivasan V, Hamza S (2010). Effect of different propagation media on seed germination, seedling growth and vigour of nutmeg (MyristicafragransHoutt.). J. Med. Plants Res. 4:2054-2058.

Archana C, Jadhav YL, Bhagure, Raundal RM. Effect of PGR, Chemicals and plant extract on seed germination and seedling growth of custard apple (*Annona squamosal*). *Asian J Hort*.;10(1):184-186

Arvind RK, Patel KM, Upadhyay NV. Effect of different growing media and containers on growth of seedlings of papaya (Carica papaya L.) cv. Madhubindu. Trends Biosci. 2015;8(1):231-235.

Boricha Urvashi K, Parmar BR, Parmar AB, Sheetal D Rathod, MV Patel and AK Pandey (2020). Effect of pre-sowing treatments on seed germination and seedling growth of guava. The Pharma Innovation Journal 2020; 9(9): 431-433.

Brijwal, M., and Kumar, R. (2013). Studies on the seed germinatio., and subsequent seedling growth of guava (*Psidium guajava* L.). Indian Journal of Agricultural Research, 47, 347-352.

Campos Mota L, Van Meeteren U, Blok C (2009). Comparison of physical properties of vermicompost from paper mill sludge and green compost as substitutes for peat based potting media. ActaHortic. 819:227-234.

Cavallaro, V., Maucieri, C., and Barbera, A. C., (2014). *Loliummultiflorum* Lam. cvs germination under simulated olive mill wastewater salinit., and pH stress. *Ecological Engineering*, 71, 113-117.

Dawood, M. G. (2018). Stimulating plant tolerance against abiotic stress through seed priming. In A. Rakshi., and H. Singh (Eds.), *Advances in Seed Priming* (p. 147-183).

Dinesh A and S Padmapriya (2022). Effect of different pre-sowing treatments on seed germination, seed coat morphology and survival of guava (Psidium guajava L.). *Journal of Pharmacognosy and Phytochemistry* 11(3): 265-269

Essien, E. P. (2004). Breaking of seed coat dormancy in guava. *Tropical Science*, 44, 4-42.

Hays WB. Fruit Growing in India. Kitabistan, Allahabad. 1953, 22-23.

Hays WB. Fruit Growing in India. Kitabistan, Allahabad. 1953, 22-23.

He, M.-X., Du, X.-F., Chen, L., Lu, X.-Y., and Lan, H.-Y. (2013). Effects of salt, alternating temperatur., and hormone treatments on seed germinatio., and seedling establishment of *Suaedaaralocaspica* (Chenopodiaceae) dimorphic seeds. Chinese Journal of Ecology, 32, 45-51.

Humphries, T., Chauhan, B. S., and Florentine, S. K. (2018). Environmental factors effecting the germinatio., and seedling emergence of two populations of an aggressive agricultural weed; *Nassellatrichotoma* PLoS ONE, 13, e0199491.

Kumari R, Sindhu SS, Sehrawat SK, Dudi OP. Germination studies on Aonla (Emblica officinalis Gaertn). *Haryana J Hort. Sci.* 2007; 36(1-2): 9-11.

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. *J Crop and Weed*, 2014; 10(2):281-286.

Kuperberg, J. Rooting guava (Psidium guajava L., c. Supreme) stem cuttings in a hydroponic mist-type plant propagator. **Florida State Horticultural Society**, Bradenton, p.220-223, 1953.

Lamichhane, J. R., Debaeke, P., Steinberg, C., You, M. P., Barbetti, M. J., and Aubertot, J.-N. (2018). Abioti., and biotic factors affecting crop seed germinatio., and seedling emergence: a conceptual framework. *Plan., and Soil*, 432, 1-28.

Maldonado-Arciniegas, F., Ruales, C., Caviedes, M., Ramírez, D. X., and León-Reyes, A. (2018). An evaluation of physica., and mechanical scarification methods on seed germination of *Vachelliamacracantha* (Humb. &Bonpl. ex Willd.) *Seigler&Ebinger. Acta Agronómica*, 67, 120-125.

Nandini S, Singh SK. Effect of growing media on seed germination and growth parameters of papaya seedlings. J Hort. Pest Sci. 2021;1(1):36-45.

Nelson, R.O. Propagation of guavas by graftage. **Florida State Horticultural Society**, Bradenton, p.228-231, 1954.

Padma L., Basvaraju G.V., Sarika G., Amrutha N. Effect of seed treatments to enhance seed quality of papaya (Carica papaya L.) cv. surya. *Global J. Biol., Agric. Health Sci.* 2013;2(3):221–225.

Pampanna Y, Sulikeri GS. Effect of growth regulators on seed germination and seedling growth of sapota. Karnataka J Agric. Sci. 2001; 14(4):1030-1036.

Panse, V. C. and Sukhatme, P. V. (1967).*Statistical Methods for Agricultural Workers*, ICAR, New Delhi.

Patil H, Tank RV, Bennurmath P, Gotur M. Effect of seed treatment and foliar spray of chemical substances on seedling growth of jamun (Syzygiumcumini L.). Int. J Chem. Stud. 2018; 5(5):1676-1680.

Pereira, F.M. Factors affecting guava production and quality with special reference to São Paulo, Brazil. **ActaHorticulturae**,The Hague, n.275, p.103-109, 1990.

Powell R. Leaf and branch of tree and tall shrub of Perth. West Australia. Department of Conservation and Land Management. ISBN. 0-7309-3912-2.

Praveen Jholgiker, Manga Bade and Anil Sabard. 2017. Germination Studies in Different Guava (*Psidium guajava* L.) Cultivars. *Int.J.Curr.Microbiol.App.Sci.* 6(5): 2826-2829.

Rakibuzzaman M, Maliha M, Dina A, Raisa I, Uddin AFM. Evaluation of growing media for seedling emergence and seedling growth of Red Lady papaya. Int. J Bus. Soc. Sci. Res. 2019;7(4):27-30.

Ramchandra, Sheogovind. GA, thiourea, ethanol and acid treatment in relation to seed germination and seedling growth in guava (*Psidium guajava* L.). *Prog. Hort.* 1990, 22(1-4).

Ramteke V, Paithankar DH, Kamatyanatti M, Baghel MM, Chauhan J, Kurrey V. Seed germination and seedling growth of papaya as influenced by GA3 and propagation media. Int. J Farm Sci. 2015;5(3):74-81.

Rashmi K , Sindhu SS, Sehrawat, SK and Dudi OP (2007). Germination studies in Aonla (*Emblica officinalis* G.). Haryana J. Hort. Sci. 36(1-2): 9-11.

Ruehle, G.D. A rapid method of propagation the guava. **California Avocado Society**, Santa Ana, n.33, p.108-112, 1948.

Salisbury FB, and Ross, CW (1988). Plant Physiology. CBS Publishers and Distributors, Delhi, pp. 319-329.

Shashikumar, 2010, Standardization of softwood grafting in guava (Psidium gujava L). M. Sc. (Hort.) Thesis, Univ. Agric. Sci., Dharwad.

Singh R. Fruits. National book trust of India, New Delhi. 1967, 87-88.

Singh R. Fruits. National book trust of India, New Delhi. 1967, 87-88.

Singh S, Soni SL. Effect of water and acid soaking periods on seed germination in guava. *Punjab Hort J*. 1974; 14(3-4):122-124.

Suryakanth LB, Mukunda GK, Raghavendraprasad GC. Studies on seed germination in guava cvs. Taiwan guava and Allahabad safeda. *Karnataka. J of Horti*. 2005; (2):47-50.

Tandon K, Gurjar PKS, Lekhi R, Soni D. Effect of organic substances and plant growth regulators on seed germination and survival of tamarind (*Tamarindus indica* L.) seedlings. *Int. J Curr. Microbiol. App. Sci.* 2019; 8(2):2270-2274.

Teketay D. Germination of Acacia origena, A. pilispina and Pterolobiumstellatum response to different presowing seed treatment, temperature and light. J Aridenviron. 1998; 14 (3-4):551-560

Vasantha PT, Vijendrakumar RC, Guruprasad TR, Mahadevamma M, Santosh KV. Studies on effect of growth regulators and biofertilizers on tamarind (*Tamarindus indica* L.). *Plant Archives*. 2014; 14(1):155- 160.

VishwakarmaDeepshikha. Effect of growing media and GA3 on seed germination, growth and survival of acid lime (Citrus aurantifolia, Swingle) var. kagz. Dept. of Hort. JNKVV. College of Agri, MP, 2012..

Webber, H.J. The guava and its propagation. California Avocado Society, Santa Ana, n.29, p.40-43, 1944.

Comment [AC13]: Most of the references used are very old and do not follow a homogeneous pattern. Authors are suggested to consult more current articles on the subject to strengthen items such as the introduction and discussion.

Table 1: Influence of potting media and GA_3 on seed germination and seedling growth of Guava (*Psidium Guajava*) cv. Allahabad safeda under shade net condition.

Level of GA3		Days to germinations	Germination (%)	Height of the seedling (cm)	Number of leaves seedling^{-1}	Stem diameter (cm)	Primary roots length (cm)	No. secondary roots
G1: GA_3 0.00PPM		44.76	72.18	26.09	12.35	1.54	5.28	16.39
G2: GA_3 400PPM		35.61	78.16	27.70	13.48	2.07	5.87	17.63
G3: GA_3 500 PPM		30.68	83.81	28.75	14.39	2.62	6.26	18.67
G4: GA_3 600 PPM		26.25	89.40	30.07	15.17	3.28	7.35	20.26
	F-Test	S	S	S	S	S	S	S
	S.Ed. (+)	0.372	0.252	0.227	0.029	0.029	0.027	0.069
	C.D. at 0.5%	0.761	0.515	0.464	0.063	0.015	0.055	0.140
Level of Potting media		**Days to germinations**	**Germination (%)**	**Height of the seedling (cm)**	**Number of leaves seedling^{-1}**	**Stem diameter (cm)**	**Primary roots length (cm)**	**No. secondary roots**
M1: Vermicuilite+ Garden Soil + Sand (1:1:1)		32.11	82.76	30.71	17.04	2.61	6.43	18.97
M2: FYM + Garden Soil + Sand (1:1:1)		35.05	80.44	28.01	13.28	2.32	6.06	17.94
M3: Cocopeat + Garden Soil + Sand (1:1:1)		36.38	78.69	25.67	10.79	2.13	6.02	17.76
M4: Vermicompost + Garden Soil + Sand (1:1:1)		33.76	81.67	28.23	14.28	2.46	6.24	18.27
	F-Test	S	S	S	S	S	S	S
	S.Ed. (+)	0.372	0.252	0.227	0.029	0.015	0.027	0.069
	C.D. at 0.5%	0.761	0.515	0.464	0.063	0.029	0.055	0.140
Int. (Due to potting media x GA_3)								
Treatment No.	**Treatment details**	**Days to germinations**	**Germination (%)**	**Height of the seedling (cm)**	**Number of leaves seedling^{-1}**	**Stem diameter (cm)**	**Primary roots length (cm)**	**No. secondary roots**
T_1	G1: 0.00 ppm + M1: Vermiculite + Garden soil + Sand	41.45	73.86	28.79	15.15	1.72	5.60	16.99
T_2	G1: 0.00 ppm + M2: FYM + Garden soil + Sand	45.44	71.94	26.37	12.38	1.52	5.06	16.20
T_3	G1: 0.00 ppm + M3: Cocopeat+ Garden soil + Sand	48.49	70.01	22.49	9.21	1.28	5.18	16.08
T_4	G1: 0.00 ppm + M4: Vermicompost+ Garden soil + Sand	43.65	72.93	26.71	12.65	1.63	5.27	16.30
T_5	G2: 400 ppm + M1: Vermiculite + Garden soil + Sand	32.89	80.30	30.06	16.77	2.32	6.02	18.06
T_6	G2: 400 ppm + M2: FYM + Garden soil + Sand	36.73	77.44	27.56	13.00	2.01	5.78	17.31
T_7	G2: 400 ppm + M3: Cocopeat+ Garden soil + Sand	37.49	75.59	25.54	10.07	1.83	5.72	17.42
T_8	G2: 400 ppm + M4: Vermicompost+ Garden soil + Sand	35.34	79.31	27.65	14.09	2.13	5.94	17.75
T_9	G3: 500 ppm + M1: Vermiculite + Garden soil + Sand	28.99	85.37	31.22	17.62	2.88	6.51	19.16
T_{10}	G3: 500 ppm + M2: FYM + Garden soil + Sand	31.21	83.31	28.52	13.95	2.52	6.16	18.47
T_{11}	G3: 500 ppm + M3: Cocopeat+ Garden soil + Sand	31.87	82.11	26.67	11.19	2.41	6.06	18.22
T_{12}	G3: 500 ppm + M4: Vermicompost+ Garden soil + Sand	30.64	84.46	28.60	14.81	2.67	6.32	18.82
T_{13}	**G4: 600 ppm + M1: Vermiculite + Garden soil + Sand**	**25.12**	**91.52**	**32.78**	**18.61**	**3.53**	**7.59**	**21.68**
T_{14}	G4: 600 ppm + M2: FYM + Garden soil + Sand	26.80	89.06	29.58	13.80	3.21	7.26	19.80
T_{15}	G4: 600 ppm + M3: Cocopeat+ Garden soil + Sand	27.66	87.05	27.96	12.69	2.99	7.11	19.33
T_{16}	G4: 600 ppm + M4: Vermicompost+ Garden soil + Sand	25.40	89.97	29.97	15.56	3.40	7.44	20.21
	F-Test	S	S	S	S	S	S	S
	S.Ed. (+)	0.744	0.503	0.227	0.051	0.029	0.054	0.137
	C.D. at 0.5%	1.522	-	0.464	0.109	0.058	0.111	0.281

Table 2: Influence of potting media and GA_3 on seed germination and seedling growth of Guava (*Psidium Guajava*) cv. Allahabad safeda under shade net condition.

Level of GA3		Fresh weight of shoots (g)	Dry weight of shoots (g)	Fresh weight of roots (g)	Dry weight of roots (g)	Seed vigour index -I	Seed vigour index -II	Leaf area (cm)
G1: GA_3 0.00PPM		9.62	3.28	1.30	0.27	1886.47	256.88	36.01
G2: GA_3 400PPM		14.01	4.42	1.54	0.63	2167.85	395.43	46.69
G3: GA_3 500 PPM		15.29	5.44	1.74	0.83	2411.68	525.93	55.23
G4: GA_3 600 PPM		16.26	6.26	1.93	1.11	2691.29	658.80	62.18
	F-Test	S	S	S	S	S	S	S
	S.Ed. (±)	0.191	0.047	0.009	0.060	9.499	6.956	0.539
	C.D. at 0.5%	0.392	0.097	0.019	0.124	19.437	14.233	1.103
Level of Potting media								
M1: Vermicuilite+ Garden Soil + Sand (1:1:1)		14.79	5.19	1.69	0.78	2551.58	502.70	53.20
M2: FYM + Garden Soil + Sand (1:1:1)		13.68	4.73	1.61	0.75	2260.18	450.16	48.65
M3: Cocopeat + Garden Soil + Sand (1:1:1)		12.65	4.51	1.56	0.60	2032.17	411.47	47.21
M4: Vermicompost + Garden Soil + Sand (1:1:1)		14.06	4.96	1.65	0.72	2313.37	472.72	51.05
	F-Test	S	S	S	S	S	S	S
	S.Ed. (±)	0.191	0.047	0.009	0.060	9.499	6.956	0.539
	C.D. at 0.5%	0.392	0.097	0.019	0.124	19.437	14.233	1.103
Int. (Due to potting media x GA_3)								
Treatment No.	**Treatment details**							
T_1	G1: 0.00 ppm + M1: Vermiculite + Garden soil + Sand	10.42	3.75	1.36	0.38	2126.46	305.08	38.88
T_2	G1: 0.00 ppm + M2: FYM + Garden soil + Sand	9.64	3.27	1.30	0.23	1896.72	251.33	34.84
T_3	G1: 0.00 ppm + M3: Cocopeat+ Garden soil + Sand	7.98	2.70	1.22	0.16	1574.43	**200.57**	**32.23**
T_4	G1: 0.00 ppm + M4: Vermicompost+ Garden soil + Sand	10.44	3.40	1.32	0.31	1948.29	270.55	38.08
T_5	G2: 400 ppm + M1: Vermiculite + Garden soil + Sand	16.54	4.76	1.63	0.71	2414.10	438.96	50.17
T_6	G2: 400 ppm + M2: FYM + Garden soil + Sand	13.60	4.21	1.50	0.63	2134.26	374.32	46.58
T_7	G2: 400 ppm + M3: Cocopeat+ Garden soil + Sand	11.80	4.16	1.45	0.54	1930.30	355.49	42.64
T_8	G2: 400 ppm + M4: Vermicompost+ Garden soil + Sand	14.10	4.55	1.56	0.66	2192.72	412.96	47.39
T_9	G3: 500 ppm + M1: Vermiculite + Garden soil + Sand	15.49	5.76	1.83	0.88	2665.66	566.87	57.40
T_{10}	G3: 500 ppm + M2: FYM + Garden soil + Sand	15.28	5.28	1.73	0.81	2375.63	507.32	54.77
T_{11}	G3: 500 ppm + M3: Cocopeat+ Garden soil + Sand	15.05	5.10	1.67	0.78	2189.69	482.83	52.38
T_{12}	G3: 500 ppm + M4: Vermicompost+ Garden soil + Sand	15.34	5.62	1.75	0.85	2415.75	546.71	56.37
T_{13}	**G4: 600 ppm + M1: Vermiculite + Garden soil + Sand**	**16.71**	**6.51**	**1.93**	**1.31**	**3000.11**	**699.87**	**66.33**
T_{14}	G4: 600 ppm + M2: FYM + Garden soil + Sand	16.18	6.18	1.93	1.14	2634.10	667.67	58.40
T_{15}	G4: 600 ppm + M3: Cocopeat+ Garden soil + Sand	15.78	6.06	1.89	0.92	2434.25	607.01	61.59
T_{16}	G4: 600 ppm + M4: Vermicompost+ Garden soil + Sand	16.35	6.28	1.97	1.06	2696.71	660.67	62.38
	F-Test	S	S	S	NS	S	NS	S

	S.Ed. (±)	0.383	0.095	0.019	0.121	18.998	13.919	1.078
	C.D. at 0.5%	0.784	0.194	0.038	-	38.874	-	2.206