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RESEARCH PAPER

TITLE:

EFFECT OF DIFFERENT POTTING MEDIA ON SEED GERMINATION ATTRIBUTES OF HOLLYHOCK (*ALTHAEA ROSEA* L.)

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EFFECT OF DIFFERENT POTTING MEDIA ON SEED GERMINATION ATTRIBUTES OF HOLLYHOCK (*ALTHAEA ROSEA* L.)

Abstract:

The present study demonstrated that potting media composition plays a crucial role in hollyhock seed germination. A mixture of canal silt, bagasse, and rice husk in equal proportions (PM4) consistently produced superior results across most germination parameters, including percentage, index, and velocity. By contrast, canal silt alone (PM1) was the least effective. These findings highlight the potential of combining readily available organic residues to enhance seed vigor and early establishment of hollyhock. For practical applications, nursery growers are recommended to adopt a 1:1:1 mixture of canal silt, bagasse, and rice husk as an economical and environmentally friendly alternative to conventional soil-based media. Future studies should investigate the long-term effects of these media on seedling growth, flowering, and overall plant performance.

Keyword: Althaea rosea, Ornamental Plants, Seed Germination, Organic Residues, Sustainable media

Introduction:

Hollyhock (*Althaea rosea* L.) is one of the most important ornamental plants from the family of Malvaceae, native to southern Europe, the middle east and central Asia. Hollyhock is an annule plant and has a wide range of flower colors including white, pink, yellow, orange, dark red and purple, the axillary and solitary flowers are often arranged into the terminal racemes, its height reached 2.5m (Pullaiah, 2006). It can be sown as rear view in landscapes or bedding plant in gardens and sown near fences and walls. Hollyhock plant has high medicinal valueswhich includesthe prevention of asthma, cough, stomach problems, throat pain and its swelling, and kidney pain, due to its mucilage contain (Parvaiz *et al*., 2015).

Most of the species of hollyhock are annual in nature and can be easily grown from seeds. This plant is afraid of hot weather and sunlight.Although Hollyhock can easily grow in warm climates,field production is limited by environmental factors and management methods. For example, limited water supply is one of the common restrictions on production. Therefore, additional watering is necessary for the commercial production of hollyhock. Even if there is a certain amount of water, the traditional method of growing plants does not allow commercial production to be maintained. For plants, it is very helpful to find ways to increase their resistance to this kind of stress. The use of plant growth regulators is a possible way to increase plant stress tolerance in other methods such as breeding and genetic engineering. the external function of some polyamines such as putrescine, spermine and spermidine increases the resistance of plants (Hyatt *et al*., 2008&Quero *et al*., 2012).

The potting medial play a pivotal role for healthy growth and production of ornamental plants. The function of a good potting medium is to provide sufficient nutrients, support plants to maintain moisture and ensure the diffusion of oxygen to the roots and the possibility of

transferring gas between the roots and the atmosphere outside the root substrate (Abad *et al*., 2002). The potting media in our vicinity is available in two formssoil and organic based. The soil based potting media contains soil as the main part, while the organic based potting media is generally obtained from organic sources, such as cake, coconut peat, peat, peat moss, perlite, vermiculite, fallen leaves or any organic matter. Most of our local nurseries cannot obtain this organic material cheaply, and farmers often use affordable and cheap local sources to prepare their own potted media. The use of potting media has been reported for many ornamental flowering plants, such as tulips, hollyhock and marigold (Kapoor *et al*., 2000; Salem *et al*., 2002;Vizier, 2005; Naz *et al*., 2006; Kiran *et al*., 2007; Rodriguez *et al*., 2010; Ali *et al*., 2011&Ikram *et al*., 2012).

The excessive use of inorganic/chemical fertilizers mediated severe environmental concerns and caused air pollution and ground water contamination. In addition to its high cost, chemical fertilizers can also inhibit bacterial activity and stabilize organic matter in the soil. It is believed that use of organic fertilizers obtained from any organic source is environmentally friendly and is pre-requisite for satisfactory growth and flowering of potted plants (Ramadan *et al*., 2002).There are special organic fertilizers available in the market for the production of high-quality seasonal flowers. Compared with inorganic fertilizers, the use of organic fertilizers is one of the ways to make the production system more sustainable without harmful effects on natural resources and the environment (Koshakinejad *et al*., 2012). Organic sources are farmyard manure, fish, sawdust, castor bone meal, coconut peat, peat moss, rice husk, etc. This can not only maintain soil fertility, but also maintain soil moisture (Yadav *et al*., 2013). Many studies have shown that organic products can be used with impressive results. Organic fertilizers and their extracts increase soil fertility by improving nutrient retention and circulation and play an important role in growth and yield (Khaled and Shafei, 2005) In this study, the effects of various growing media on hollyhock seed germination were studied.

Materials and Methods:

The experiment was conducted during winter 2021 at Horticulture Garden, Faculty of Crop Production, Sindh Agriculture University, Tandojam. To investigate the effect of potting media on seed germination attributes of Hollyhock. The experiment was laid out in completely randomized design (CRD) with three replications. The seeds of (Scarlet) variety were sown in the earthen pots filling with different potting media that included PM_1=canal silt (Control), PM_2= canal silt + bagass (1:1), PM_3=canal silt + rise husk (1:1) and PM_4=canal silt + bagass+ rise husk (1:1:1). The seed germination and other seed related attributes were recorded, and data were statistically analyzed using statistics 8.1 computer software (Statistix, 2006). The LSD test was applied to compare treatments superiority, where necessary at 5% Level of Probability.

Different parameters of calculated the germination were below mention.

1. Coefficient velocity of germination (CVG):

The coefficient of velocity of germination (CVG) is a measure of how quickly seeds

germinate. Its value rises when more seeds sprout in a shorter duration. Jones and Sanders (1987) proposed the following formula to determine CVG: CVG=N1+N2+…+Nx/100×N1T1+…+Nx/Tx

2. First day of germination (FDG)

On the first day, the seeds swell as they absorb moisture. By the next day, a small white protrusion appeared. In the next 2-3 days, this structure stretches, and behind the tips appear thin hair-like extensions. Kader et al. (1998) provided the following formula to determine the first day of germination: FDG= the day on which the first germination event occurred.

3. Final germination percentage (FGP)

The final germination rate represents the percentage of all tested seeds that have successfully germinated (Lai et al., 2 0 1 9 & Zhang et al., 2020). GF refers to the percentage of seeds that germinate at peak times compared to the seeds tested. Scott et al. (1984) introduced the following formula to calculate the final germination rate: FGP=Final no. Seeds germinated in seed batch x100.

4. Germination index (GI)

The germination index (GI) quantifies the germination rate and percentage. Benech Arnold et al., (1991). proposed the following formula to calculate the germination index: GI=(10=n1)+(9=n2)....(1=n10).

5. Germination rate of index (GRI)

According to Benech Arnold et al. (1991), the germination rate index (GRI) is the weighted total of the daily numbers of seeds that germinate.

GRI=G1/1+G2/2+…+Gx/x.

According to Benech Arnold et al., (1991), the germination rate index (GRI) is a weighted sum of the number of days the seed has germinated.

Grid = G1/1+G2/2+...+Gx/x.

6. Last day of germination (LDG)

Determine the last day of germination according to the method described by Al-Mudaris (1998). To calculate the last day of germination, the following formula is used: LDG = the day on which the first germination event occurred.

7. Mean germination rate (MGR)

The average germination rate is determined as the reciprocal of the average germination time. Ellis (1981) provided the following formula for its calculation: MGR=G1/1+G2/2+...Gx/x.

8. Mean germination time (MGT)

Mean germination time indicates the average duration required for seed germination, emphasizing the day when the majority of seeds have sprouted. Orchard (1977) proposed the following formula to calculate the mean germination time: MGT=∑f.x/∑f.

9. Seed germination percentage (SGP)

The germination rate is used as an indicator of the vitality of the seed population. Scott et al. (1984) For the calculation the following formula was introduced: germinated seed×100/total seed.

10. Time spread germination (TSG)

TSG represents the distribution of germination over time (Bewley et al., 2013). The following formula, (Kader et al., 1998 & Yadav et al., 2013) Used to calculate germination rate:

TSG=Number of days between the first and last germination event that occurred in the seed batch.

Results and Discussion

Seed Germination Percentage

The analysis of variance showed that significant ($P<0.05$) influence of potting media on the seed germination of Hollyhock. The results regarding the seed germination percentage of hollyhock as influenced by different potting media has been shown in (Table-1). The seed germination percentage (SGP) of experimental results ranged from (20.98 to 56.78%). The highest germination percentage was recorded in PM_4 (56.78%) followed by PM_2 (39.50%). The lowest seed germination percentage was noted in PM_1 (20.98%) where only canal silt was used as a potting media. The findings of this study are consistent with the findings of (Gawankar et al., 2019) who found that the effect of different potting media on seed germination and seedling growth in jackfruit (Artocarpus heterophyllus Lam.) containing soil, vermicompost, cocopeat, and rice husk in a 1:1:1:1 proportion was best for obtaining the maximum germination percentage of 93.0% was observed, with germination initiation at 11.88 days, 50% germination at 22.88 days, and complete germination at 24.25 days (Panchal et al., 2014, Meena et al., 2015 & Purwantoro, 2016) reported that incorporating vermicompost and rice husk enhances germination by improving nutrient availability, pH balance, and organic carbon levels. These findings align with previous research on papaya by (Arvind, 2024 & Ramteke et al., 2015).

Germination Index

The analysis showed the significant ($P<0.05$) influence of potting media on the germination index (GI) hollyhock. The results regarding the germination index of hollyhock as influenced by different potting media has been shown in (Table-1). The germination index (GI) of experimental results ranged from (0.37 to 0.78). The highest germination index was recorded in PM_4 (0.78) followed by PM_2 (0.70). The lowest germination index was noted in PM_1 (0.37). where only canal silt was used as a growing media. The results show highest germination percentage and index due to the more portion of vermicompost as it contains a lot of mineral nutrients, active soil enzymes and microbes (Domínguez, 2014).

Germination Rate of Index

The analysis showed the significant ($P<0.05$) influence of potting media on the germination rate of index (GRI) hollyhock. The results regarding the germination rate of index of hollyhock as influenced by different potting media has been showed in (Table-1). The germination rate of index (GRI) ranged from (36.10 to 50.00). The highest germination rate of index in PM_2(66.66), followed by PM_4(50.00). The lowest germination rate of index PM_1 (36.10) where only canal silt was used as a growing media. Our findings revealed that gibberellic acid alone had minimal impact on the seed germination index. However, when combined with sowing media, it contributed to an improved germination rate. This suggests that gibberellic acid plays a crucial role in the early stages of germination, particularly in breaking dormancy, while the growing medium becomes essential for later stages, such as

radicle protrusion and seedling emergence. These results are consistent with the findings of (Bhardwaj et al., 2016).

Table 1. Seed Germination Percentage (SGP), Germination Index (GI), Germination Rate of Index (GRI) in Hollyhock Seed Under different potting media.

Treatment	(SGP)	(GI)	(GRI)
PM_1=Control	20.98C	0.37 D	36.10 C
PM_2=Canal silt+ Bagass (1:1)	39.50 B	0.70 B	66.66 A
PM_3=Canal silt+ Rice husk (1:1)	29.62 C	0.52 C	66.66 A
PM_4=Canal Silt+ bagass+ Rice husk (1:1:1)	56.78 A	0.78 A	50.00 B
LSD	22.59	0.67	40.25
SE	9.79	0.29	17.45
P-Value	0.03	0.54	0.30
CV	32.68	60.23	38.98

Mean Germination Rate

The analysis showed the significant ($P<0.05$) influence of potting media on the mean germination rate (MGR) hollyhock. The results regarding the mean germination rate of hollyhock as influenced by different potting media has been showed in (Table-2). The mean germination rate (MGR) ranged from (0.00 to 0.01). The highest mean germination rate in PM_3 and PM_4(0.01), The lowest mean germination rate PM_1 and PM_2 (0.00), whereas the results was not significant. After three weeks of cultivation, no significant variation in mean germination rate was observed across different culture media, including the control, regardless of seed type. The absence of a notable difference between basal media and the agar-only control suggests that macro- and microelements were not essential for Bambara groundnut germination. Instead, seed germination success appeared to be primarily dependent on water availability. This observation aligns with the findings reported by (Edalatifard et al., 2016).

Mean Germination Time

The analysis showed the significant ($P<0.05$) influence of potting media on the mean germination time (MGT) hollyhock. The results regarding the mean germination time of hollyhock as influenced by different potting media has been showed in (Table-2). The mean germination time (MGT) ranged from (0.93 to 0.27). The highest mean germination time in PM_1(0.93), followed by PM_3(0.54). The lowest mean germination time PM_2 (0.26). the result was significant. the mean germination time (MGT) and mean germination rate (MGR) for three seed types grown in different culture media after a 3-week incubation period. The MGT remained unaffected by the tested culture media, regardless of seed type. However, seed type significantly influenced germination time across all media. The embryo axis (EA) germinated the fastest (4–5 days), followed by seeds without a seed coat (SWtC), which sprouted in 8–9 days. In contrast, seeds with a seed coat (SWC) required 10–14 days for germination (Figure 2). The delay in germination observed in seeds with or without a seed coat, compared to the embryo axis, may be attributed to the time required for water to penetrate the seed coat, hydrate the cotyledons, and initiate the physiological germination process. Similarly, (Maliro and Kwapata, 2000).

Coefficient Velocity Germination

The analysis showed the significant ($P<0.05$) influence of potting media on the coefficient velocity germination (CVG) hollyhock. The

results regarding the coefficient velocity germination of hollyhock as influenced by different potting media has been showed in (Table-2). The coefficient velocity of germination (CVG) ranged from (0.85 to 2.30). The highest coefficient velocity of germination in PM_4(2.30), followed by PM_3(1.20). The lowest coefficient velocity of germination PM_2 (0.70). the result was significant.

Table 2. Mean Germination Rate (MGR) Mean Germination Time (MGT) and Coefficient Velocity Germination (CVG) in Hollyhock Seed Under different potting media.

Treatment	(MGR)	(MGT)	(CVG)
PM_1=Control	0.00 B	0.93 A	0.85 C
PM_2=Canal silt+ Bagass (1:1)	0.00 B	0.26 D	0.70 D
PM_3=Canal silt+ Rice husk (1:1)	0.01 A	0.54 B	1.20 B
PM_4=Canal Silt+ bagass+ Rice husk (1:1:1)	0.01 A	0.27 C	2.30 A
LSD	0.01	0.65	0.80
SE	4.51	0.28	0.34
P-Value	0.07	0.13	0.00
CV	47.54	69.19	33.63

First Day of Germination

The analysis showed the significant ($P<0.05$) influence of potting media on the first day of germination (FDG) hollyhock. The results regarding the first day of germination of hollyhock as influenced by different potting media has been showed in (Table-3). The first day of germination (FDG) ranged from (3.66 to 2.66). The highest first day of germination in PM_1 (3.66), followed by PM_2(3.00). The lowest first day of germination PM_3 (2.33), whereas the results were significant.

Final Germination Percentage

The analysis showed the significant ($P<0.05$) influence of potting media on the final germination percentage (FGP) hollyhock. The results regarding the final germination percentage of hollyhock as influenced by different potting media has been showed in (Table-3). The final germination percentage (FGP) ranged from (3.33 to 56.78). The highest final germination percentage in PM_4 (56.78), followed by PM_2(39.50). The lowest final germination percentage PM_3 (29.62), whereas the results were significant.

Last Day of Germination

The analysis showed the significant ($P<0.05$) influence of potting media on the last day of germination (LDG) hollyhock. The results regarding the last day of germination of hollyhock as influenced by different potting media has been showed in (Table-3). The last day of germination (LDG) ranged from (8.33 to 12.66). The highest last day of germination in PM_4 (12.66), followed by PM_3(9.33). The lowest last day of germination PM_1 (8.33), whereas the results were significant.

Time Spread Germination

The analysis showed the significant ($P<0.05$) influence of potting media on the time spread germination (TSG) hollyhock. The results regarding the time spread germination of hollyhock as influenced by different potting media has been showed in (Table-3). The time spread germination (TSP) ranged from (6.66 to 10.33). The highest time spread germination in PM_4 (10.33). The lowest time spread germination PM_1-PM_3 (6.66), whereas the results were not significant.

Table 3. First Day of Germination (FDG), Final Germination Percentage (FGP), Last Day of Germination (LDG) and Time Spread Germination (TSP) in Hollyhock Seed Under different potting media.

Treatment	(FDG)	(FGP)	(LDG)	(TSG)
PM_1=Canal silt	3.66 A	33.33C	8.33D	6.66B
PM_2=Canal silt+ Bagass (1:1)	3.00 B	39.50B	9.00C	6.66B
PM_3=Canal silt+ Rice husk (1:1)	2.33 D	29.62D	9.33B	6.66B
PM_4=Canal Silt+ bagass+ Rice husk (1:1:1)	2.66 C	56.78A	12.66A	10.33A
LSD	2.10	28.89	4.41	4.83
SE	0.91	12.52	1.91	2.09
P-Value	0.53	0.21	0.18	0.27
CV	38.33	38.54	23.85	33.83

Conclusion

The present study provides valuable insights into seed germination and its potential. Among the different potting media tested, PM_4 canal silt + bagasse + rice husk (1:1:1) resulted in the highest seed-related attributes. This potting mixture significantly accelerated germination and enhanced various seed characteristics. Seed vigor was closely linked to germination performance under potting media. While most seed parameters improved with potting media, the final days to germination remained unaffected.

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