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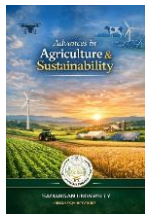

Effects of animal manures on phenological characteristics of Ghazi-Khani melon

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Keywords
Gazikhani melon, maturity period, phenology, animal manure, flowering

Research/Review Article

Abstract

Under Afghanistan's agricultural conditions, low soil organic matter is a major constraint limiting optimal plant growth and influencing irrigation, fertilization, and harvesting practices. This study investigated the effects of different animal manures (chicken, cow, and sheep) on the phenological indices of Ghazi Khani melon to identify the most effective type and application rate. The experiment was conducted in 2024 at Samangan University using a randomized complete block design with seven treatments, including a control and varying levels of three manure types, each with three replications. Data were analyzed using ANOVA in SPSS, and means were compared using Duncan's test at the 0.05 level. Results showed that sheep manure at 30 tons per hectare produced the best outcomes in most phenological traits, including germination, leafing, flowering, fruiting, and phenological duration. It reduced germination time and accelerated flowering. Cow manure also improved leaf growth and flowering, while chicken manure

had moderate effects. Overall, targeted manure use enhances phenological development and soil fertility.

1. Introduction

In the present era, sustainable agriculture is considered one of the fundamental pillars of natural resource management. The use of organic resources, especially animal fertilizers such as cow and sheep manure, is considered one of the effective ways to improve soil quality, improve plant nutrition and increase crop yields. These fertilizers have a significant impact on the physiology and various stages of plant growth; therefore, investigating their role in regulating and improving plant phenological indicators is of particular importance. One of the economically valuable crops in warm and semi-warm regions is melon (Cucumis melo L.). This plant has multiple and sensitive phenological stages, the effective management of which plays a key role in improving yield. According to the BBCH scale, plant growth stages are divided into ten basic stages, including: germination stage (0), leaf growth (1), shoot growth (3), inflorescence emergence (5), flowering (6), fruit development (7), fruit ripening (8), and senescence or onset of vegetative dormancy (9) (Brown, 2021). In recent years, the use of this scale to analyze plant phenological stages has been accepted as a scientific and standard tool. For example, Kishore (2017) found in his research on Phyllanthus emblica that this scale is effective for better management of plant irrigation and nutrition. Similarly, Mendes et al. (2017) quantitatively analyzed the thermal requirements and timing of plant growth stages in their research on Annona squamosa.

Various researches have investigated the effect of nutritional management on the phenological stages of plants. Doaie et al (2019) at Gonbad Kavous University investigated the effect of planting date, nitrogen and bio inoculation on phenology, light use efficiency, and yield of chickpea and concluded that inoculation with Mazarisobium and application of 60 kg of nitrogen per hectare increased grain yield and planting date played a decisive role in changing phenological stages. Similarly, Namwar and Seyed Sharifi (2011) in Lithuania found that a combination of biological and chemical nutrition accelerated flowering and improved chickpea yield. Anwar et al (2003) in New Zealand studied the effect of planting date and irrigation on the phenology of Kabuli chickpea and reported that nitrogen fertilizer improved growth and flowering. Shaban et al (2011) observed that drought stress reduced

phenological, morphological, and yield traits of chickpea; Nitrogen improved yield only under non-stress conditions. Verma et al (2013) reported in India that the use of native Mesozobium and growth-promoting bacteria increased nitrogen uptake and improved phenological growth stages of chickpea. Soltani et al (2006) reported that temperature and nitrogen were the determining factors in the speed of chickpea phenological stages. Similarly, Leak and Sedras (2017) in Australia found that proper nutrition increased light absorption and accelerated growth, ultimately improving chickpea yield. In a study on rapeseed, Karimian et al (2009) showed that higher nitrogen application increased leaf area index, light absorption, and growth rate. Shabani et al (2017) in Fars Province showed that combined use of biofertilizers, nano-nitrogen, and chemical nitrogen in soybean resulted in better growth, earlier flowering, and higher yield. A study in 2024 at the Samangan University Research Farm investigated the effect of cow and chicken manure on the growth and yield of Sabzak melon. The results showed that cow manure increased the weight, length, diameter and number of melon fruits (Safdary et al., 2024). At the Tabriz University Research Farm, Ahmadi et al (1398) reported that chicken manure treatment (20 tons/ha) reduced the germination period of eggplant from 9 to 7 days and increased the number of leaves and the rate of branch growth by 15%. (Montazeri et al., 2020) in the Khuzestan region showed that the use of 30 tons of cow manure caused a slight delay in the onset of corn inflorescence, but improved flowering and grain quality. Rezaei et al. (2018) reported in northern Iran that the use of 15 tons of sheep manure accelerated the growth of strawberry fruit and reduced the time to fruit ripening from 50 to 42 days. In Pakistan, Jan et al (2018) studied the effect of six levels of potassium on maize and found that up to 100 kg/ha, potassium reduced the number of days required for the emergence of male threads, flowering and ripening. San Martin et al. (2021) reported that increasing potassium during the fruit production stage of eggplant increased the content of sugar, vitamin C, lycopene and beta-carotene. Amanullah et al (2016) also found at the University of Peshawar that potassium applied in soil and as a foliar spray at different growth stages improved germination, leaf area index, grain number and yield of maize. Andrianari et al (2021) found that phosphorus deficiency in rice caused a 9–16-day delay in heading and reduced yield, while the addition of 50 kg P_2O_5 reduced heading time and increased yield by 20%.

Numerous researches have shown that the use of organic fertilizers such as cow and chicken manure, due to the presence of nutrients such as nitrogen, phosphorus, potassium, calcium and magnesium, in addition to improving soil fertility, increases crop growth and yield. Despite much research on the phenology of various plants, there has been no complete and field study on the effect of various types of animal manure on the phenological indicators of melon. This lack of research has prevented farmers from accurately determining the exact timing of irrigation, feeding and harvesting; which can lead to reduced yield, poor product quality and inefficient use of resources. This research is based on the hypothesis that: "The use of cow and sheep manure can significantly affect the phenological indicators of melon." In other words, it is predicted that fertilizer treatments will accelerate or improve the stages of germination, flowering, fruiting and ripening of melon. The secondary objectives of this study include comparing the effects of cow and sheep manure on the speed and regularity of melon phenological stages, investigating the effect of combining these fertilizers on growth coordination, evaluating the reduction of environmental stresses through improving soil organic matter and measuring the response of melon to different levels of animal manure application. The main objective of this reseach is to quantitatively and qualitatively investigate the effects of cow and sheep manure on melon phenological indicators; indicators such as germination period, flowering onset time, fruiting period, and final maturity. This study is designed to provide scientific evidence to optimize melon planting management in the country's climatic conditions. This study can also be effective in better decision-making by farmers, increasing the economic productivity of planting, and developing sustainable agriculture in the long term. The findings of this study can pave the way for further studies on the interaction of soil, organic matter, and the growth of other agricultural plants.

2. Material and Methods

This investigation was conducted in 2024 in Aibak city, Samangan province, on the grounds of Samangan Institute of Higher Education. The aim of the study was to investigate the effect of various types of animal fertilizers on the growth and yield of phenological indices of melon cultivar Ghazi Khani. The climatic conditions of the region, soil type and agricultural facilities of the experimental site were such that it was possible to accurately implement the experimental design and uniformly manage the treatments throughout the growing season. This experiment was designed and implemented in a

randomized complete block design (RCBD) with seven treatments and three replications to scientifically and comparably evaluate the effect of different levels of animal fertilizers on melon phonological indices. Fertilizer treatments included control (no fertilizer application), cow manure at two levels of 30 and 60 tons per hectare, sheep manure at two levels of 30 and 40 tons per hectare, and chicken manure at two levels of 5 and 15 tons per hectare. These levels were selected based on common agricultural applications and the purpose of the study.

Before the experiment and the beginning of the cultivation operation, the main plots were determined according to the experimental plan at the site of the project and the planting bed was prepared in the form of furrows. Then, cow, sheep and chicken manure were added uniformly to the planting bed based on the amounts determined for each treatment to provide suitable nutritional conditions for the initial growth of the plant. The area of each experimental plot was considered to be 2 meters long and 2 meters wide, and after the furrow preparation was completed, initial irrigation was carried out to provide the necessary moisture for germination. The melon seeds were planted unilaterally on 26 Saur 2024. Irrigation was carried out regularly throughout the growing season and every 7 days, based on the water requirement of the plant, to prevent moisture stress at different stages of growth and to provide uniform conditions for comparing the effects of fertilizer treatments. Other required agricultural operations were also applied equally in all plots.

The traits studied in this study included phenological indices of Ghazi Khani melon, which included the stages of bud growth, leaf growth, branch growth, inflorescence emergence, flowering, fruit growth, fruit maturity, senescence, and dormancy onset. Data related to these indices were collected separately from each replication and for each treatment to increase the accuracy and validity of the results. After completing data collection, statistical analysis was performed using SPSS version 25, so that the analysis of variance (ANOVA) method was used to examine the effect of fertilizer treatments, and Duncan's multiple range test was used at the $p<0.05$ probability level to compare the mean traits. Also, for better visual presentation of the results, tables and graphs were drawn using Excel.

3. Results

1. Germination

In examining the germination time, it was observed that the sheep manure treatment of 30 tons per hectare recorded the fastest germination time with an average of 3.66 days. This treatment showed a significant difference compared to other treatments, especially the control treatment, which had the longest germination. Cow manure and chicken manure also had a positive effect on accelerating germination, but showed a relative delay compared to sheep manure (Figure 1).

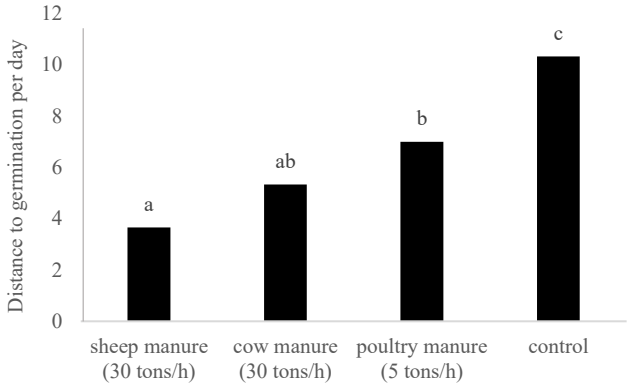

Figure 1: Shows the effect of treatments on the distance to germination of Ghazi Khani melon.

2. Leaf initiation

The results of the study showed that the time of leaf initiation was affected by the type of fertilizer used, and cow manure at 30 tons per hectare had the best performance in accelerating leaf formation. This treatment caused the plants to enter the leaf initiation stage about 10 days earlier than the control treatment. After that, sheep and chicken manure had favorable effects, but cow and sheep manure showed a significant difference compared to the control treatment (Figure 2).

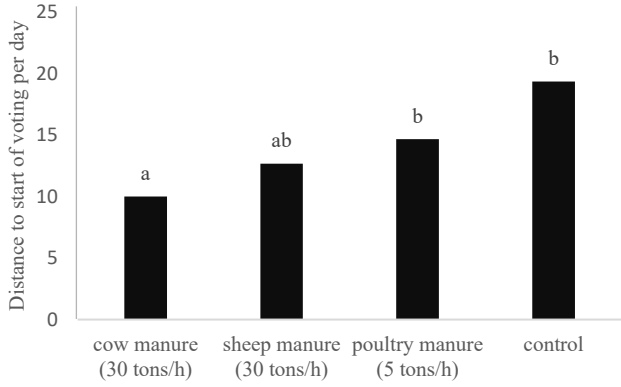

Figure 2: Shows the effect of treatments on the interval to leafing of Ghazi Khani melon.

3. Flowering

The results of the evaluation analysis showed that the effect of sheep manure treatment of 30 tons per hectare had the best result in flowering and the plants under this treatment entered the flowering stage 34 days after planting. Cow manure also had a similar performance, but the flowering time was slightly longer than that of chicken manure and the control, which had a significant difference (Figure 3).

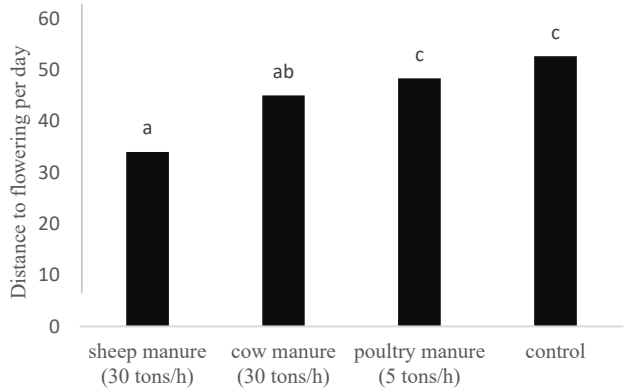

Figure 3: Shows the effect of treatments on flowering of Ghazi Khani melon.

4. Flowering period

The results of the study showed that the flowering period was affected by animal fertilizers and significantly different from the control. The most effective treatment was 30 tons of cow manure per hectare, which provided more time for insemination and fruit formation. Sheep manure, chicken manure and the control treatment had a shorter flowering period (Figure 4).

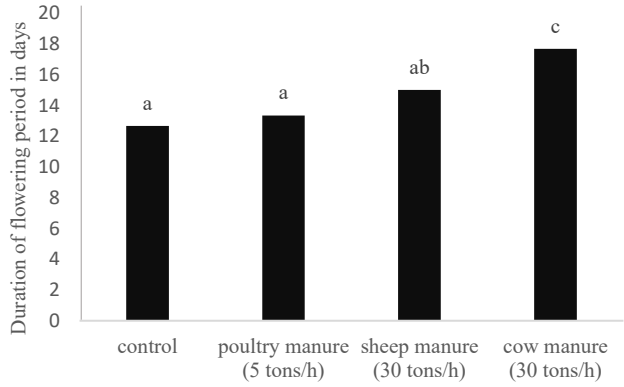

Figure 4: Shows the effect of treatments on the flowering period of Ghazi Khani melon.

5. Fruiting

The results of data analysis showed that the effect of applying animal fertilizers had a significant effect on fruiting of the crop. Sheep manure 30 tons per hectare and cow manure 30 tons per hectare showed the best effect in accelerating fruiting. Chicken manure and the control treatment had the greatest delay, which was significantly different from the sheep and cow treatments (Figure 5).

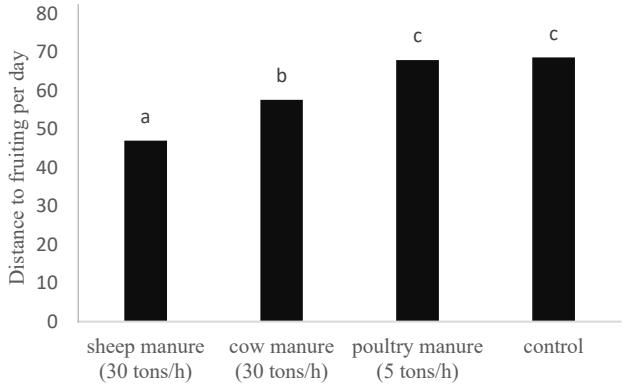

Figure 5: Shows the effect of treatments on the interval to fruiting of Ghazi Khani melon.

6. Fruit maturity period

The effect of treatments was not significantly different among the animal manure treatments, but they were significantly different from the control. All three treatments of sheep, cow and chicken manure showed relatively similar performance and reduced the maturity period compared to the control. The control treatment required a longer period for the fruit to reach maturity, indicating nutritional limitation that slowed down the full development of the fruit (Figure 6).

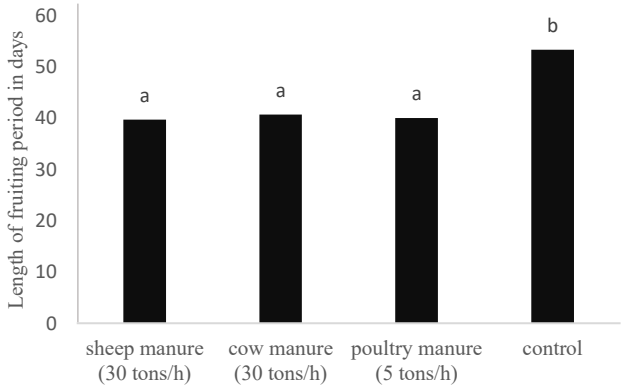

Figure 6: Shows the effect of treatments on the length of the fruiting period of Ghazi Khani melon.

7. Number of leaves per plant

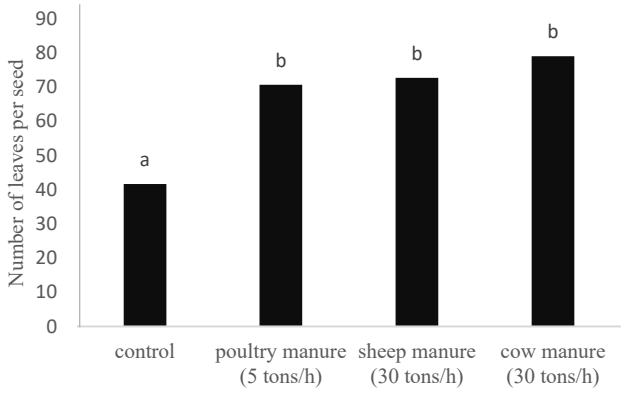

Figure 7: Shows the effect of treatments on the number of leaves of Ghazi Khani melon.

The results of the experiment showed that cow manure at 30 tons per hectare had the greatest effect on increasing the number of leaves. After that, sheep and chicken manure also had positive and close effects, with no significant difference between them, but there was a significant difference compared to the control treatment (Figure 7).

8. Number of fruits per plant

The evaluation results showed that the effect of sheep and cow manure increased the number of fruits per plant, which was significantly different from the control treatment. Sheep manure 30 tons per hectare produced the highest number of fruits and the control treatment produced the lowest number of fruits per plant (Figure 8).

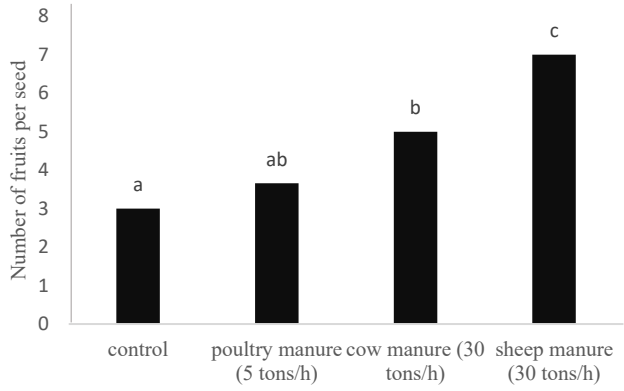

Figure 8: Shows the effect of treatments on the number of fruits on Ghazi Khani melon plants.

9. Defoliation

The study of leaf drop rates showed that there was no significant difference between the different manure treatments. All treatments performed relatively similarly in terms of leaf drop, only the control treatment showed a higher rate of leaf drop, which could be due to the plant's weakness in maintaining vegetative integrity due to nutrient deficiency. Therefore, manures were effective in stabilizing leaves and preventing leaf drop.

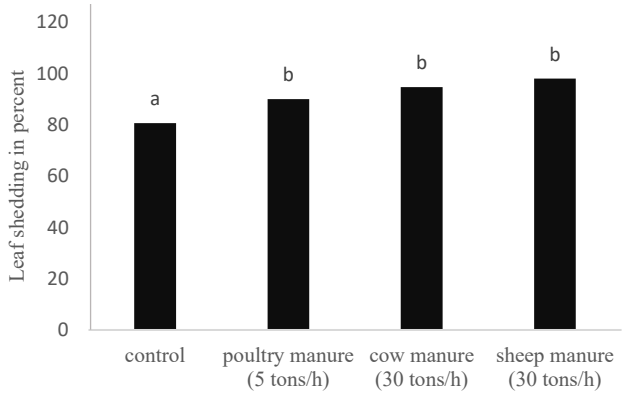

Figure 9: Shows the effect of treatments on leaf shedding of Ghazi Khani melon.

10. Phenological period length

The phenological period includes the period from germination to harvest, and showed significant differences in different treatments compared to the control. The shortest period belonged to the sheep and cow manure treatment, which indicated a balanced and faster growth of plants under these conditions. Poultry manure also reduced the phenological period, but there was no significant difference compared to the control treatment (Figure 10).

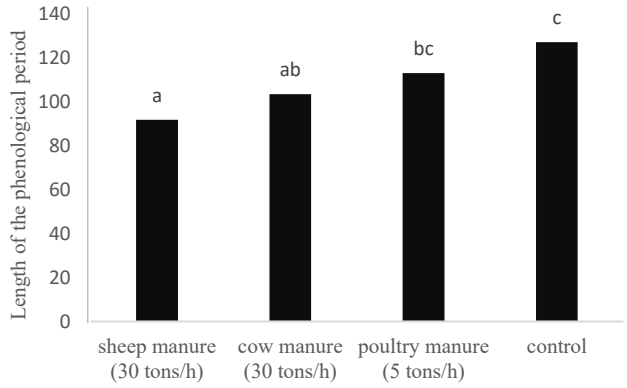

Figure 10: Shows the effect of treatments on the length of the phenological period of Ghazi Khani melon.

4. Conclusion and Discussion

The findings of this study showed that the application of animal fertilizers, especially sheep and cow manure at a rate of 30 tons per hectare, had a significant effect on improving the phenological and growth indices of melon. Among them, accelerated germination, increased number of leaves and fruits, accelerated flowering and fruit maturity, and reduced leaf fall were observed. This highlights the importance of using organic fertilizers in low-yield cropping systems such as Afghanistan. Therefore, it is suggested that the use of sheep or cow manure be considered as a suitable alternative to chemical fertilizers.

In this investigation, the effect of various animal manures on the phenological indicators of melon plants has been studied with scientific accuracy. Treatment with sheep manure at a rate of 30 tons per hectare accelerated the germination process, which is probably due to the presence of nitrogen and absorbable organic matter in it, and according to the findings of Yudav et al (2013), the use of organic agriculture in northern India has improved soil stability, reduced environmental pollution, increased crop health and long-term productivity, and is a suitable alternative to harmful chemical fertilizers and pesticides. The acceleration of flowering under the influence of sheep manure is probably due to the better provision of elements such as phosphorus and potassium, which play a key role in the formation of flower buds; a finding that Sun Liqing et al (2023) also achieved in the case of 6 perennial flowers. Also, cow manure, by providing continuous nutrition, has increased the flowering period and improved pollination conditions; A topic that Marak et al (2020) showed that organic fertilizers such as animal

manure and compost along with bio-fertilizers helped improve plant phenological indicators such as flowering time, flowering duration, and number of flowers. On the other hand, increasing the speed of fruiting using cow and sheep manure indicates the role of these fertilizers in rapidly providing nutrients and stimulating growth hormones such as gibberellins; also, simultaneous use of cow manure and GA_3 significantly increases fruit growth and number, indicating the role of cow manure in stimulating gibberellin pathways, which is consistent with the results reported by (Tasmim et al., 2023). The reduction in fruit ripening period under the influence of animal manure application is probably due to the improvement of root nutritional status and increased carbohydrate production; A finding in a study by El Gammal and Salama in 2016 reported a significant reduction in the duration of the maturation period using sheep manure (El Gammal & Salama, 2016), which is consistent with current observations. In this regard, the increase in the number of leaves per plant under the influence of cow manure could be due to the stable provision of nitrogen and appropriate moisture for better growth of the green parts of the plant; this is consistent with the issue reported by Arzad et al. in 2017 on the effect of applying different amounts of cow manure on the growth of mustard plants, where the use of cow manure had a significant effect on plant height, number of leaves, plant fresh weight, total leaf area and total plant dry weight, and the dose of 25 tons per hectare of cow manure gave the best result for mustard plants (Arzad, Tambing and Bahrudin., 2017). The use of sheep manure had the greatest effect on increasing the number of fruits per plant and enhanced flowering and fruit stabilization; As (Yahaya et al., 2023) have also confirmed this. Also, the reduction in leaf fall in treatments with animal manure is related to the strengthening of the plant tissue structure and balanced nutrition, which is consistent with the findings of Ceretta et al. in 2005, which reported a reduction in leaf fall due to strengthening the tissue structure and balanced nutrition (Ceretta et al., 2005). As a result, cow and sheep manures have reduced the total duration of the plant phenological period, which can be explained by accelerating general growth and full access to nutrients; the result reported by Xie et al. in 2025 that the application of animal manure reduces the length of the phenological period by accelerating general growth and greater access to nutrients is consistent with the findings of Xie et al. in 2025 (Xie et al., 2025). Future research should investigate soil–plant mechanisms and practical feasibility of animal manure in different conditions, multi-site and multi-season experiments, pre- and post-soil analysis.

5. Statements and Declarations

5.1 Competing interests

The author/s have no competing interests relevant to the subject of this study.

Competing interests

The author/s have no competing interests.

5.2 Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

5.3 Ethics Approval

Not applicable. This investigation did not involve human participants or animals.

Approval for animal experiments

Not applicable

Approval for human experiments

Not applicable.

Ethical Approval

Not applicable.

5.4 Consent to participate/Consent to publish

Not applicable.

Consent to Participate/Consent to Publish

Not Applicable

5.5 Funding

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5.7 Author Contributions

Conceptualization: Ali Jawed Safdary and Azimudden Akbari; Methodology: Ali Jawed Safdary, Wahidullah Parsa, and Azimudden Akbari; Investigation: Abdul Rahman Samady, Wahidullah Ahmadi, Ali Jawed Safdary, and Wahidullah Parsa; Writing—Original Draft: Ali Jawed Safdary and Wahidullah Parsa; Writing—Review & Editing: Ali Jawed Safdary and Wahidullah Parsa; Resources: Abdul Rahman Samady and Wahidullah Ahmadi; Supervision: Azimudden Akbari, Wahidullah Parsa, and Abdul Rahman Samady.

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