**Influence of pre-sowing seed treatments and growing media on performance of consecutive sowing for constant production of Fenugreek microgreens (*Trigonella foenum-graecum* L.) under shade net**

**Abstract**

The present investigation entitled "Influence of pre-sowing seed treatments and growing media on performance of consecutive sowing for constant production of Fenugreek microgreens (*Trigonella foenum-graecum* L.) under shade net" was performed at the College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli, Dist. Ratnagiri. The experiment was laid out in a split-plot design with two factors, eight treatment combinations and three replications. Factor A comprised two pre-sowing seed treatments: W1: Water soaking of seed and W2: without soaking, while, Factor B included four growing media: M1: Soil + FYM (3:1), M2: Coarse Sand, M3: Cocopeat and M4: Soil + Cocopeat (1:1).

The data recorded during investigation revealed that the pre-sowing seed treatments and media influenced the growth, yield and quality parameters of fenugreek microgreens. Among two pre-sowing seed treatments, W1 (Water soaking of seed) had superior effect on all growth, yield and quality parameters than the W2 (Without soaking). Among various growing media M4-Soil + Cocopeat (1:1) found superior in some growth parameters like, days for germination (avg. 3.39), leaf length (avg.2.01 cm) and leaf breadth (avg. 0.82 cm); yield (avg. 678.20 g/m2)and more number of harvesting cycles (avg.13.46).

 The treatment combination W1M4-[Watersoaked seeds + Soil + Cocopeat (1:1)] performed better in terms of days to germination (avg. 2.88), leaf length (avg. 2.04 cm), leaf breadth (avg. 0.84 cm), yield parameter *viz*., days required for harvest (8.33), yield (avg. 1505.57 g/m2), number of cycles (avg. 15) in 6 months and quality parameters *viz*., Vitamin C (60.76 mg/100 g) and Vitamin A (0.55 mg/100 g) resulted into more B:C ratio (2.67).

**Keywords:** Fenugreek mocrogreens, media, seed treatments, cocopeat

**Introduction**

Fenugreek (Trigonella foenum-graecum L.), an annual leafy vegetable, belongs to the Leguminosae family and is widely farmed in Asia and the Mediterranean region **[1]**. It is also known as *Methi* (Hindi and Marathi) or Fenugreek (French) [2]. The species name foenum-graecum, which translates to "Greek hay," is where the word fenugreek originates [3]. The two species of Trigonella that are economically significant are T. corniculata, also known as the Kasuri methi and T. foenum graecum, also known as the common methi. It is a slow-growing variety that spends the majority of its vegetative development phase in rosette state [4].

Fenugreek grows in a wide range of climatic conditions and is more adaptable than other plants. It can withstand frost and freezing temperatures and needs a cool climate. Low temperatures are necessary for the crop's early stages in order to promote greater vegetative growth [5].

The term "microgreens" refers to the tiny, fragile seedlings of several crop species that are either eaten raw or partially cooked. "Microgreens," also known as "Nutrigreens," are young edible greens of many types of vegetables, herbs and plants that are harvested while they are little and full of taste and nutrients. The first pair of genuine leaves are either partly or fully developed, while the cotyledonary leaves have fully expanded. These seedlings are typically described as "green" in hue [6]. Micogreens typically consist of roots, a central stem, two cotyledonary leaves and often the first pair of very young true leaves. Plants are ready for harvesting when they reach a height of approximately 2 to 3 inches (5 to 7.5 cm), typically 10 to 14 days after germination [7].

The concentration of nutrients in microgreens is greater than that of mature herbs and vegetables. Microgreens have 40 times the amount of some vitamins, such as vitamin E, that mature plants do. They are rich source of minerals such as K, Fe, Zn, Mg and Cu [8]. Microgreens are generally thought to be a high source of lutein, violaxanthin, α-carotene and β-carotene.

When growing fenugreek microgreens outside, gardeners typically utilize soil medium, which can lead to damping off or root rot issues. Growers frequently experience damping off, which is brought on by the pathogen *Rhizoctonia solani* [9]. *Rhizoctonia solani* attacks seedlings at the base, causing them to finally die. Heavy soils that hold on to a lot of moisture cause damping off and other problems. Therefore, in order to solve this issue and achieve the highest possible level of subsequent cycles of fenugreek microgreen production, it is necessary to choose the best growth medium.

Microgreens are an annual crop that farmers may cultivate to supplement their income and provide variety to their business. Therefore, choosing the right growing medium and applying a pre-sowing seed treatment are essential for boosting growth.

**Material and methods**

The field experiment was carried out at the Department of Vegetable Science, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during the year 2023-24. There were two factors and total 8 treatment combinations replicated three times using the split plot design. Factor A is composed of two factors concerned with pre-sowing seed treatments: W1: Water soaking of seed; W2: Without soaking, whereas Factor B is composed of four media combinations: M1: Soil + FYM (3:1), M2: Coarse sand, M3: Cocopeat and M4: Soil + Cocopeat (1:1). The treatment combinations are as follows: W1M1- Water soaking of seed + Soil + FYM (3:1), W1M2- Water soaking of seed + Coarse sand, W1M3- Water soaking of seed + Cocopeat, W1M4-Water soaking of seed + Soil + Cocopeat (1:1), W2M1- Without soaking + Soil + FYM (3:1), W2M2- Without soaking + Coarse sand, W2M3- Without soaking + Cocopeat, W2M4- Without soaking + Soil + Cocopeat (1:1). The Fenugreek seeds were soaked for overnight in accordance with treatment guidelines. The microgreens are harvested at the stage when their cotyledon leaves are fully opened, with or without emergence of the first pair of true leaves. Fenugreek microgreens were harvested separately as per the harvesting stage within 8–12 days; the harvesting period varied within treatments. Total 5 plants from each treatment were randomly selected as observational plants to record the observations at time of harvesting. The observations are recorded on different growth parameters like days required for germination, height of seedlings (cm) and yield parameters like days required for harvest, number of cycles per month, total number of cycles in 6 months, yield/m2.

**Results and Discussion**

**Days required for germination**

The data presented in Table 1 recorded the significant effect of pre-sowing seed treatments and media on the number of days required for germination of fenugreek microgreens throughout the experiment. The minimum number of days required for germination was reported in W1 (Watersoaking of seed) in the month of October (3.13 days), November (3.17 days), December (3.17 days), January (3.17 days), February (3.29 days) and March (3.29 days), while maximum number of days were found in W2 (Without soaking) ) in the month of October (3.96 days), November (3.96 days), December (3.96 days), January (3.96 days), February (4.08 days) and March (4.08 days). Soaking the seeds accelerated germination by a high percentage of emergence in a shorter amount of time, Ponnuswamy and Vijayalakshmi [10]. According to Jamil et al. [11], cv. Fasalabad Long required a minimum of 5.77 days to emerge when seeds were soaked for 16 hours, followed by 12 hours (5.88 days). Parallel results were noted in cucumber by Shakuntala et al. [12], Saleem et al. [13] in bitter gourd .The growing media showed early germination in M4 [Soil + Cocopeat (1:1)], in the month of October (3.33 days), November (3.33 days), December (3.33 days), January (3.33 days), February (3.50 days) and March (3.50 days). In tomato seedlings, cocopeat + soil (1:1) had the maximum germination percentage (94.17 %) within 14 days, according to Panthi et al. [14]. Archana and Lal [15] found that the minimum number of days required for germination is 9 to 11 days when mung beans are grown in cocopeat medium. Similar results were also reported by Priyadarshini and Kumari [16] in onion microgreens. In case of interaction however the late germination was noted in M2 (Coarse sand) *viz*., in October (3.92 days), November (3.92 days), December (3.92 days), January (3.92 days), February (4 days) and March (4 days). In case of interaction of pre-sowing seed treatments and media, the minimum number of days required for germination was observed in W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] such as in October (2.83 days), November (2.83 days), December (2.83 days), January (2.83 days), February (3 days) and March (3 days). The W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] required minimum number of days for fenugreek microgreens to germinate. This might be attributed to the fact that soaking the seeds before sowing accelerated germination in W1 (Water soaking of seed), however the media M4 [Soil + Cocopeat (1:1)] had sufficient nutrient (Table: 17), moisture (Table: 16) and aeration availability which was responsible for the minimum days for germination found in W1M4.

**Seedling height** (cm)

The data presented in Table 2. reported that the maximum seedling height in M3 (Cocopeat) *viz.,* in October (5.03 cm), November (5.18 cm), December (5.88 cm), January (5.52 cm), February (5.29 cm) and March (4.97 cm), while the minimum was found in M2 (Coarse sand) *i.e.*, October (4.50 cm), November (4.67 cm), December (4.84 cm), January (4.78 cm), February (4.72 cm) and March (4.16 cm). Arya and Kutty [17] observed that the maximum height was 5.8 cm in amaranth in cocopeat medium. Reshma and Sarath [18] observed the maximum plant height (69.36 cm) of tomato in cocopeat medium. In interaction maximum seedling height was recorded in W1M3 (Water soaking of seed + Cocopeat) *i.e.,* October (5.04 cm), November (5.20 cm), December (5.88 cm), January (5.53 cm), February (5.30 cm) and March (4.98 cm), however the lowest was noted in W2M2 (Without soaking + Coarse sand) *i.e*., October (4.49 cm), November (4.74 cm), December (4.83 cm), January (4.77 cm), February (4.70 cm) and March (4.14 cm). The highest seedling height was recorded in W1M3 (Water soaking of seed + Cocopeat) it might be due to the soaked seeds germinate more quickly and consistently, which resulted in more vigorous development and possibly taller plants. Similarly as Cocopeat is more porous, providing better aeration and drainage which might have improved uptake of nutrients.

**Days required for harvest**

The data presented in Table 3 revealed that the minimum number of days required for harvest was recorded in W1 (Water soaking of seed) in the month of October (8.79 days), November (8.83 days), December (8.67 days), January (8.79 days), February (9.52 days) and March (9.63 days), while maximum number of days required for harvest were found in W2 (Without soaking) ) in the month of October (9.71 days), November (9.46 days), December (9.50 days), January (9.63 days), February (10.42 days) and March (10.42 days). The growing media showed early harvesting in M4 [Soil + Cocopeat (1:1)], in the month of October (8.75 days), November (8.50 days), December (8.50 days), January (8.67 days), February (9.50 days) and March (9.42 days). In case of interaction however the late harvesting was noted in M2 (Coarse sand) *viz*., in October (10.25 days), November (10.17 days), December (10 days), January (10.17 days), February (11.08 days) and March (11.17 days). Sinha and Thilakacathy [19] found that the minimum days (8) required for harvest in fenugreek and amaranthus microgreen with coco pith medium. Dalal et al. [20] note the minimum 7 days required for first true leaves in carrot and spinach microgreens noted in cocopeat and rice husk (1:1). In case of interaction of pre-sowing seed treatments and media, the minimum number of days required for harvest was observed in W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] such as in October (8 days), November (8 days), December (8 days), January (8 days), February (9 days) and March (9 days), while maximum number of days for harvest was noted in W2M2 (Without soaking + Coarse sand) *i.e*., in October (10.50 days), November (10.33 days), December (10.50 days), January (10.67 days), February (11.67 days) and March (11.67 days). The data concluded that the treatment combination W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] recorded lowest number of days to harvest. It might be because soaking accelerated the primary stage of growth, while the medium promoted continuous growth, which could shorten the time required for harvesting.

**Number of cycles per month**

Table 4 represents data on the impact of pre-sowing seed treatments and media on fenugreek microgreens. The highest number of cycles was observed in W1 (Water soaking of seed) *i.e*., 2.29, however the lowest were noted in W2 (Without soaking) *i.e*., 2.12. The maximum number of cycles per month (avg. 2.45) was reported in M4 [Soil + Cocopeat (1:1)], while the minimum (2.01) were noted in M2 (Coarse sand). In interaction the maximum number of cycles (2.61) were observed in W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] and the minimum (1.97) were reported in W2M2 (Without soaking + Coarse sand). Water soaked seeds resulted faster and uniform germination, which could enabled quicker establishment and faster initial growth phase of fenugreek microgreens. The media soil + Cocopeat contained higher concentration of N, P, K after Cocopeat (Table: 17) along with micro-nutrients, which might be enhanced the availability of essential nutrients for the growth and produced more number of cycles in Soil + Cocopeat compared to other. Therefore, maximum number of cycles per months were noticed in W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)].

**Yield (g/m2)**

The data presented in Table 5 and Fig 1 reported that the maximum yield was noted in W1 (Water soaking of seed) *i.e*., in October (829.92 g), November (484.40 g), December (912.15 g), January (505.65 g), February (853.51 g) and March (483.56 g), however the lowest were noted in W2 (Without soaking) *i.e*., in October (458.04 g), November (290.56 g), December (510.42 g), January (350.93 g), February (347.85 g) and March (315.24 g). In growing media maximum yield were found in M4 [Soil + Cocopeat (1:1)] *i.e*., in October (1324.14 g), November (725.10 g), December (1505.06 g), January (785.79 g), February (1409.67 g) and March (766.43 g), however the lowest were noted in M3 (Cocopeat) *i.e*., in October (101.76 g), November (98.97 g), December (237.20 g), January (158.81 g), February (151.12 g) and March (84.61 g). Archana and Lal (2021) recorded the highest yield (75 %), in soil + cocopeat media in mung bean and adzuki bean microgreens. Priyadarshini and Kumari [16] noticed the highest yield of 7.68 g in cocopeat medium. The outcomes were parallel to those of Arya and Kutty [17] in green gram, Naik et al. [21] in mustard microgreens and Allah et al. [22] in mustard microgreens. In interaction the maximum yield was observed in W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] *i.e*., in October (1775.22 g), November (977.15 g), December (2196 g), January (946.05 g), February (2202.33 g) and March (936.67 g), however the lowest were noted in W2M3 (Without soaking + Cocopeat) *i.e*., in October (88.22 g), November (65.67 g), December (177.11 g), January (96.43 g), February (122.06 g) and March (64.19 g). The data evident that W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] had a significantly higher yield per m2. It might be due to the soaking seeds promoted germination and early growth, while Soil + Cocopeat medium provided all essential nutrients and aeration for production of maximum yield.

**Total cycles in 6 month**

The data presented in Table 6 and Fig 2 revealed that the maximum number of cycles in 6 month (13.46) were found in W1 (Water soaking of seed), while the minimum (12.83) were reported in W2 (Without soaking). In growing media the maximum number of cycles in 6 months (14) were recorded in M4 [Soil + Cocopeat (1:1)] and minimum was noted in M2 (Coarse sand). In case of interaction the maximum number of cycles (15) were noticed in W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] and minimum (11.67) in W2M2 (Without soaking + Coarse sand). The data revealed that W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] had the maximum number of cycles in 6 months. This might be due to soaked seeds resulted in faster and uniform germination, which could enabled quicker establishment and faster initial growth phase of fenugreek microgreens. The media Soil + Cocopeat contained higher concentration of N, P, K after Cocopeat along with micro-nutrients might be enhanced the availability of essential nutrients for the growth which produced maximum number of cycles in Soil + Cocopeat compared to other.

Table 1. **Monthwise variation in days required for germination of fenugreek microgreens as affected by pre-sowing seed treatments and media**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment** | **October** | **November** | **December** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 3.00 | 3.83 | 2.83 | 2.83 | **3.13** | 3.00 | 3.83 | 3.00 | 2.83 | **3.17** | 3.00 | 3.83 | 3.00 | 2.83 | **3.17** |
| **W2** | 4.00 | 4.00 | 4.00 | 3.83 | **3.96** | 4.00 | 4.00 | 4.00 | 3.83 | **3.96** | 4.00 | 4.00 | 4.00 | 3.83 | **3.96** |
| **Mean** | **3.50** | **3.92** | **3.42** | **3.33** | **3.54** | **3.50** | **3.92** | **3.50** | **3.33** | **3.56** | **3.50** | **3.92** | **3.50** | **3.33** | **3.56** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.06 | 0.16 | **SIG** | 0.03 | 0.10 | **SIG** | 0.03 | 0.09 | **SIG** |
| **M** | 0.08 | 0.26 | **SIG** | 0.08 | 0.23 | **SIG** | 0.08 | 0.23 | **SIG** |
| **W X M** | 0.12 | 0.36 | **SIG** | 0.11 | 0.33 | **SIG** | 0.11 | 0.33 | **SIG** |
| **Treatment** | **January** | **February** | **March** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 3.00 | 3.83 | 3.00 | 2.83 | **3.17** | 3.17 | 3.83 | 3.17 | 3.00 | **3.29** | 3.17 | 3.83 | 3.17 | 3.00 | **3.29** |
| **W2** | 4.00 | 4.00 | 4.00 | 3.83 | **3.96** | 4.17 | 4.17 | 4.00 | 4.00 | **4.08** | 4.17 | 4.17 | 4.00 | 4.00 | **4.08** |
| **Mean** | **3.50** | **3.92** | **3.50** | **3.33** | **3.56** | **3.67** | **4.00** | **3.58** | **3.50** | **3.69** | **3.67** | **4.00** | **3.58** | **3.50** | **3.69** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.03 | 0.10 | **SIG** | 0.08 | 0.26 | **SIG** | 0.08 | 0.26 | **SIG** |
| **M** | 0.08 | 0.23 | **SIG** | 0.08 | 0.26 | **SIG** | 0.08 | 0.26 | **SIG** |
| **W X M** | 0.11 | 0.33 | **SIG** | 0.12 | 0.36 | **SIG** | 0.12 | 0.36 | **SIG** |

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| **Factor A: Pre-sowing seed treatments**  | **Factor B :Growing media**  |
| W1 : Water soaking of seed | M1 : Soil + FYM (3:1) | M2 : Coarse sand |
| W2 : Without soaking | M3 : Cocopeat | M4 : Soil + Cocopeat (1:1) |

Table 2: **Monthwise variation in seedling height (cm) of fenugreek microgreens as affected by pre-sowing seed treatments and media**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment** | **October** | **November** | **December** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 4.84 | 4.50 | 5.04 | 4.91 | **4.82** | 4.81 | 4.77 | 5.20 | 5.10 | **4.97** | 4.90 | 4.84 | 5.88 | 5.83 | **5.36** |
| **W2** | 4.82 | 4.49 | 5.01 | 4.88 | **4.80** | 4.79 | 4.74 | 5.15 | 5.03 | **4.93** | 4.86 | 4.83 | 5.87 | 5.78 | **5.34** |
| **Mean** | **4.83** | **4.50** | **5.03** | **4.90** | **4.81** | **4.80** | **4.76** | **5.18** | **5.06** | **4.95** | **4.88** | **4.84** | **5.88** | **5.80** | **5.35** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.01 | - | **NS** | 0.01 | - | **NS** | 0.01 | - | **NS** |
| **M** | 0.02 | 0.05 | **SIG** | 0.01 | 0.04 | **SIG** | 0.02 | 0.05 | **SIG** |
| **W X M** | 0.02 | 0.07 | **SIG** | 0.02 | 0.06 | **SIG** | 0.02 | 0.07 | **SIG** |
| **Treatment** | **January** | **February** | **March** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 4.90 | 4.78 | 5.53 | 5.38 | **5.15** | 4.80 | 4.74 | 5.30 | 4.98 | **4.96** | 4.61 | 4.17 | 4.98 | 4.91 | **4.67** |
| **W2** | 4.88 | 4.77 | 5.50 | 5.32 | **5.12** | 4.75 | 4.70 | 5.27 | 4.95 | **4.92** | 4.58 | 4.14 | 4.95 | 4.86 | **4.63** |
| **Mean** | **4.89** | **4.78** | **5.52** | **5.35** | **5.13** | **4.78** | **4.72** | **5.29** | **4.97** | **4.94** | **4.59** | **4.16** | **4.97** | **4.89** | **4.65** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.01 | - | **NS** | 0.01 | - | **NS** | 0.01 | - | **NS** |
| **M** | 0.02 | 0.06 | **SIG** | 0.01 | 0.04 | **SIG** | 0.02 | 0.05 | **SIG** |
| **W X M** | 0.03 | 0.08 | **SIG** | 0.02 | 0.06 | **SIG** | 0.02 | 0.06 | **SIG** |

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| **Factor A: Pre-sowing seed treatments**  | **Factor B :Growing media**  |
| W1 : Water soaking of seed | M1 : Soil + FYM (3:1) | M2 : Coarse sand |
| W2 : Without soaking | M3 : Cocopeat | M4 : Soil + Cocopeat (1:1) |

Table 3: **Monthwise variation in days required for harvest of fenugreek microgreens as affected by pre-sowing seed treatments and media**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment** | **October** | **November** | **December** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 8.67 | 10.00 | 8.50 | 8.00 | **8.79** | 8.67 | 10.00 | 8.67 | 8.00 | **8.83** | 8.67 | 9.50 | 8.50 | 8.00 | **8.67** |
| **W2** | 9.50 | 10.50 | 9.33 | 9.50 | **9.71** | 9.50 | 10.33 | 9.00 | 9.00 | **9.46** | 9.50 | 10.50 | 9.00 | 9.00 | **9.50** |
| **Mean** | **9.08** | **10.25** | **8.92** | **8.75** | **9.25** | **9.08** | **10.17** | **8.83** | **8.50** | **9.15** | **9.08** | **10.00** | **8.75** | **8.50** | **9.08** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.08 | 0.24 | **SIG** | 0.05 | 0.16 | **SIG** | 0.03 | 0.10 | **SIG** |
| **M** | 0.11 | 0.34 | **SIG** | 0.08 | 0.23 | **SIG** | 0.04 | 0.13 | **SIG** |
| **W X M** | 0.16 | 0.48 | **SIG** | 0.11 | 0.33 | **SIG** | 0.06 | 0.18 | **SIG** |
| **Treatment** | **January** | **February** | **March** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 9.00 | 9.67 | 8.50 | 8.00 | **8.79** | 9.50 | 10.50 | 9.07 | 9.00 | **9.52** | 9.67 | 10.67 | 9.17 | 9.00 | **9.63** |
| **W2** | 9.33 | 10.67 | 9.17 | 9.33 | **9.63** | 10.00 | 11.67 | 10.00 | 10.00 | **10.42** | 10.17 | 11.67 | 10.00 | 9.83 | **10.42** |
| **Mean** | **9.17** | **10.17** | **8.83** | **8.67** | **9.21** | **9.75** | **11.08** | **9.53** | **9.50** | **9.97** | **9.92** | **11.17** | **9.58** | **9.42** | **10.02** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.03 | 0.10 | **SIG** | 0.02 | 0.07 | **SIG** | 0.08 | 0.24 | **SIG** |
| **M** | 0.10 | 0.32 | **SIG** | 0.09 | 0.27 | **SIG** | 0.09 | 0.28 | **SIG** |
| **W X M** | 0.15 | 0.46 | **SIG** | 0.13 | 0.39 | **SIG** | 0.13 | 0.39 | **SIG** |

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| --- | --- |
| **Factor A: Pre-sowing seed treatments**  | **Factor B :Growing media**  |
| W1 : Water soaking of seed | M1 : Soil + FYM (3:1) | M2 : Coarse sand |
| W2 : Without soaking | M3 : Cocopeat | M4 : Soil + Cocopeat (1:1) |

Table 4: **Monthwise variation in number of cycles per month of fenugreek microgreens as affected by pre-sowing seed treatments and media.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment** | **October** | **November** | **December** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 2.83 | 2.17 | 3.00 | 3.00 | **2.75** | 2.00 | 2.00 | 2.00 | 2.33 | **2.08** | 2.08 | 2.17 | 3.00 | 3.00 | **2.56** |
| **W2** | 2.00 | 2.00 | 2.83 | 2.83 | **2.42** | 2.00 | 2.00 | 2.00 | 2.00 | **2.00** | 2.00 | 2.00 | 2.57 | 2.83 | **2.35** |
| **Mean** | **2.42** | **2.08** | **2.92** | **2.92** | **2.58** | **2.00** | **2.00** | **2.00** | **2.17** | **2.04** | **2.04** | **2.08** | **2.78** | **2.92** | **2.46** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.03 | 0.10 | **SIG** | 0.03 | - | **NS** | 0.07 | - | **NS** |
| **M** | 0.07 | 0.22 | **SIG** | 0.04 | 0.13 | **SIG** | 0.09 | 0.26 | **SIG** |
| **W X M** | 0.10 | 0.31 | **SIG** | 0.06 | 0.18 | **SIG** | 0.12 | 0.37 | **SIG** |
| **Treatment** | **January** | **February** | **March** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 2.00 | 2.00 | 2.00 | 2.33 | **2.08** | 2.00 | 2.00 | 2.17 | 3.00 | **2.29** | 2.00 | 2.00 | 2.00 | 2.00 | **2.00** |
| **W2** | 2.00 | 2.00 | 2.00 | 2.00 | **2.00** | 2.00 | 2.00 | 2.00 | 2.00 | **2.00** | 2.00 | 1.83 | 2.00 | 2.00 | **1.96** |
| **Mean** | **2.00** | **2.00** | **2.00** | **2.17** | **2.04** | **2.00** | **2.00** | **2.08** | **2.50** | **2.15** | **2.00** | **1.92** | **2.00** | **2.00** | **1.98** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.03 | - | **NS** | 0.03 | 0.09 | **SIG** | 0.03 | - | **NS** |
| **M** | 0.04 | 0.13 | **SIG** | 0.04 | 0.13 | **SIG** | 0.04 | - | **NS** |
| **W X M** | 0.06 | 0.18 | **SIG** | 0.06 | 0.18 | **SIG** | 0.06 | - | **NS** |

|  |  |
| --- | --- |
| **Factor A: Pre-sowing seed treatments**  | **Factor B :Growing media**  |
| W1 : Water soaking of seed | M1 : Soil + FYM (3:1) | M2 : Coarse sand |
| W2 : Without soaking | M3 : Cocopeat | M4 : Soil + Cocopeat (1:1) |

Table 5: **Monthwise variation in yield (g/m2) of fenugreek microgreens as affected by pre-sowing seed treatments and media**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment** | **October** | **November** | **December** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 845.17 | 584.00 | 115.30 | 1775.22 | **829.92** | 510.22 | 318.19 | 132.26 | 977.15 | **484.40** | 721.30 | 434.00 | 297.28 | 2196.00 | **912.15** |
| **W2** | 453.37 | 417.52 | 88.22 | 873.06 | **458.04** | 392.15 | 231.37 | 65.67 | 473.04 | **290.56** | 859.34 | 191.11 | 177.11 | 814.11 | **510.42** |
| **Mean** | **649.27** | **500.76** | **101.76** | **1324.14** | **643.98** | **451.08** | **274.78** | **98.97** | **725.10** | **378.48** | **790.32** | **312.56** | **237.20** | **1505.06** | **711.28** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.16 | 0.47 | **SIG** | 1.08 | 3.20 | **SIG** | 1.22 | 3.75 | **SIG** |
| **M** | 1.53 | 4.72 | **SIG** | 1.54 | 4.75 | **SIG** | 1.29 | 3.57 | **SIG** |
| **W X M** | 2.17 | 6.68 | **SIG** | 2.18 | 6.71 | **SIG** | 1.83 | 5.53 | **SIG** |
| **Treatment** | **January** | **February** | **March** |
| **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 521.62 | 333.77 | 221.18 | 946.05 | **505.65** | 537.30 | 494.22 | 180.19 | 2202.33 | **853.51** | 544.26 | 348.30 | 105.04 | 936.67 | **483.56** |
| **W2** | 477.30 | 204.45 | 96.43 | 625.54 | **350.93** | 412.15 | 240.19 | 122.06 | 617.00 | **347.85** | 357.41 | 243.19 | 64.19 | 596.19 | **315.24** |
| **Mean** | **499.46** | **269.11** | **158.81** | **785.79** | **428.29** | **474.72** | **367.20** | **151.12** | **1409.67** | **600.68** | **450.83** | **295.74** | **84.61** | **766.43** | **399.40** |
|  | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 4.67 | 14.05 | **SIG** | 4.50 | 13.60 | **SIG** | 2.06 | 6.54 | **SIG** |
| **M** | 8.74 | 26.93 | **SIG** | 2.75 | 8.46 | **SIG** | 4.11 | 12.65 | **SIG** |
| **W X M** | 12.36 | 38.09 | **SIG** | 3.89 | 11.97 | **SIG** | 5.81 | 17.89 | **SIG** |

|  |  |
| --- | --- |
| **Factor A: Pre-sowing seed treatments**  | **Factor B :Growing media**  |
| W1 : Water soaking of seed | M1 : Soil + FYM (3:1) | M2 : Coarse sand |
| W2 : Without soaking | M3 : Cocopeat | M4 : Soil + Cocopeat (1:1) |

Table 6: **Effect of pre-sowing seed treatments and media on total cycles in 6 month of
 fenugreek microgreens**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **M1** | **M2** | **M3** | **M4** | **Mean** |
| **W1** | 13.17 | 11.83 | 13.83 | 15.00 | **13.46** |
| **W2** | 12.00 | 11.67 | 13.67 | 14.00 | **12.83** |
| **Mean** | **12.58** | **11.75** | **13.75** | **14.00** | **13.15** |
|  | **S.Em.±** | **CD at 5%** | **Result** |
| **W** | 0.05 | 0.15 | **SIG** |
| **M** | 0.09 | 0.28 | **SIG** |
| **W X M** | 0.13 | 0.41 | **SIG** |

|  |  |
| --- | --- |
| **Factor A: Pre-sowing seed treatments**  | **Factor B: Growing media**  |
| W1:Water soaking of seed | M1: Soil + FYM (3:1) | M2: Coarse sand |
| W2: Without soaking | M3: Cocopeat | M4: Soil + Cocopeat (1:1) |

Fig. 1: **Effect of pre-sowing seed treatments and media on yield (g/m2) of fenugreek**

 **microgreens.**

|  |  |
| --- | --- |
| **Factor A: Pre-sowing seed treatments**  | **Factor B: Growing media**  |
| W1:Water soaking of seed | M1: Soil + FYM (3:1) | M2: Coarse sand |
| W2: Without soaking | M3: Cocopeat | M4: Soil + Cocopeat (1:1) |

Fig. 2: **Effect of pre-sowing seed treatments and media on number of cycles in 6 months**

|  |  |
| --- | --- |
| **Factor A: Pre-sowing seed treatments**  | **Factor B: Growing media**  |
| W1:Water soaking of seed | M1: Soil + FYM (3:1) | M2: Coarse sand |
| W2: Without soaking | M3: Cocopeat | M4: Soil + Cocopeat (1:1) |

**Conclusion**

The present study entitled"Influence of pre-sowing seed treatments and growing media on performance of consecutive sowing for constant production of Fenugreek microgreens (*Trigonella foenum-graecum* L.) under shade net" concluded that, W1 (Water soaking of seed) had positive effect on all growth, yield and quality parameters than the W2 (Without soaking). Among various growing media, M4-Soil + Cocopeat (1:1) found superior in some growth parameters like, days for germination, leaf length, leaf breadth; yield and more number of harvesting cycles. Ultimately, the treatment combination W1M4 [Water soaking of seed + Soil + Cocopeat (1:1)] found superior in most of the growth parameters *viz.,* minimum days for germination, leaf length and leaf breadth; yield parameters viz., days required for harvest, number of cycles in 6 month, yield g/m2, yield kg/plot and yield q/ha as well as quality parameters, however these findings must be verified by repeating the study for two to three seasons.

**Disclaimer (Artificial Intelligence)**

Authors here by declare that No generative AI technologies such as large language models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

**References**

1. Khorshidian, N., Asli, M. Y., Arab, M., Mortazavian, A. M. and Mirzaie, A. A. (2015). Fenugreek: Potential application as a functional food and nutraceutical. *Nutrition and Food Sci. Res.,* **3**(1): 5-16.
2. Shrinivasan, K. (2006). Fenugreek (*Trigonella foenum graecum*): A review of health beneficial physiological effects. *Food Reviews International*, 22: 203–224.
3. Flammang, A. M., Cifone, M. A., Erexson, G. L. and Stankowski, L. F. (2004). Genotoxicity testing of a fenugreek extract. *Food and Chemical Toxicology,* **42**(11): 1769-75.
4. Ghadge, S., Shaikh, A. A., Jadhav, J. D., Sthool, V. A., Bhosale, A. B. and Bagade, S.V. (2021). Performance of Fenugreek (*Trigonella foenum-graecum* L.) Varieties for Table Purpose under Kharif Season. *Int. J. Curr. Microbiol. App. Sci*., **10**(02): 2408-2421.
5. Singh, A., Singh, S. and Sharma, R. (2020). Nutritional potentials and nutrient profile of fenugreek (*Trigonella foenum-graecum* L.). *Int. J. Curr. Microbiol. App. Sci*., **9**(10): 3606-3615.
6. Mishra, G. P., Kumar, R. R. and Singh, A. (2021). Brochure of one day online workshop on ‘Microgreens for health and wellness’. Organized by Society for Plant Biochemistry and Biotechnology and ICAR-Indian Agricultural Research Institute, New Delhi. p. 2.
7. Koley, T. K., Maurya, A. and Singh, B. (2016). Microgreens from vegetables: more nutrition for better health*. New Age Protected Cultivation*, **2**(2): 25-27.
8. Xiao, Z., Codling, E. E., Luo, Y., Nou, X., Lester, G. E. and Wang, Q. (2016). Microgreens of Brassicaceae: mineral composition and content of 30 varieties. *J. Food Composition and Analysis*, **49**(6): 87–93.
9. Desai, S., Gangadharappa, P. Hiremath, J., Nishani, S., Pushpa, T. and Rathod, V. (2022). Response of fenugreek genotypes against *Rhizoctonia solani,* causing damping off. *The Pharma Innovation J*., **11**(6): 255-258.
10. Ponnuswamy, A. S. and Vijayalakshmi, V. (2011). Standardization of soaking duration and volume of solution for fortification of tomato, brinjal and chilli seeds. *Madras Agric. J.,* **98**(10-12): 370-371.
11. Jamil, E., Zeb, S., Ali, Q. S., Ahmad, N., Sajid, M., Siddique, S. and Saleem, M. S. (2016). Effect of seed soaking on seed germination and growth of bitter gourd cultivars. *Pure Appl. Biol*., **5**(1): 31-36.
12. Shakuntala, N. M., Kavya, K. P., Sangeetha, I. M., Kurnalliker, V. and Patil, M. G. (2020). Studies on standardization of water soaking duration on seed quality in cucumber (*Cucumis sativus* L.) seeds. *J. Pharmacognosy and Phytochemistry,* **9**(4): 1400-1404.
13. Saleem, M. S., Sajid, M., Ahmed, Z., Ahmed, S. and Islam, S. U. (2014). Effect of seed soaking on seed germination and growth of bitter gourd cultivars. *IOSR J. Agriculture and Veterinary Sci.,* **6**(6): 7-11.
14. Panthi, S., Neupane, P. and Bhusal, A. (2023). Effect of different nutrient media in growth and health of tomato seedlings in arghakhanchi district (nepal). *Asian J. of Agric. and Hortic. Research,* **10**(2): 40-48.
15. Archana, P. J. and Lal, N. S. (2021). Different culture media used for low scale production of some common microgreens*, J. of Advances in Biological Sci*., **8**(2): 63-71.
16. Priyadarshini, V. M. and Kumari, P. M. (2021). Influence of growing media on herbage yield of onion (*Allium cepa* L.) microgreens*. International J. of Botany Studies,* **6**(5): 1376-1378.
17. Arya, K. S. and Kutty, M. S. (2022). Influence of seed treatment and growing media on six species of microgreens. *J. Food Sci. Nutr*., **5**(2): 106.
18. Reshma, T. and Sarath, P. S. (2017). Standardization of growing media for the hydroponic cultivation of Tomato. *Int. J. Curr. Microbiol. App. Sci.,* **6**(7): 626-63.
19. Sinha, M. and Thilakavathy, S. (2021). Comparative study on Nutrients of Microgreens Cultivated in Soil, Water and Coco pith. *International Web Conference on Food Technology and Nutrition – Prospects for Health.,* **3**(4): 73-77.
20. Dalal, D., Mainani, R., Thakker, R. and Solanki, H. (2022). A study of selected microgreens in soil-less media, *Int. & Peer-Reviewed J.,* **1**(2): 228-230.
21. Naik, B. P. K., Sekhar, G., Suryakumari, A., Rajulu, G. S. G., Harshini, K. and Deepika S. A. (2022). Effect of growth and yield of mustard (*Brassica juncea*) microgreens on different growing medias inindoor condition. *Int. J. of Horti. and Food Sci.*,  **4**(2): 106-108.
22. Allah, S. M., Dimita, R., Negro, C., Luvisi, A., Gadaleta, A., Mininni, C. and Bellis, L. D. (2023). Quality evaluation of mustard microgreens grown on peat and jute substrate. *Horticulturae,* **9**(598): 1-10.