Short Communication

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Ex vitro Germination Behavior of *Fagonia indica* Seeds (Medicinal Plant) in Maharashtra, India

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Fagonia indica Burm. f. is an important medicinal plant species from the genus Fagonia. It belongs to the Zygophyllaceae family. It is a compact, spiny shrub that may be found in many warm and dry regions throughout multiple nations, including India, Iran, Egypt, and Mauritania [1]. The germination of its seeds is characterized by low efficacy, resulting in limited dispersal capabilities [2]. Although *F. indica* has limited distribution in specific areas of Maharashtra state, it is still being subjected to excessive harvesting, which poses a significant threat to its survival. The limited amount of phytochemicals and absence of sustainable harvesting methods for wild-grown plants pose significant obstacles in developing phytochemically consistent Fagonia products [3]. The presence of a limited amount of phytochemicals in *Fagonia indica* can impact the potential health benefits or medicinal properties of products derived from it. Phytochemicals are compounds found in plants that may have various therapeutic effects. *F. indica* contains considerable secondary metabolites, including various alkaloids, triterpenoids, flavonoids, saponins, coumarins, and tannins [4]. Researchers who have looked at the extract from this outstanding plant have found that it can combat high blood pressure, heat, inflammation, microbes, diabetes, pain, and liver protection. It may also combat cancer in its early stages [5-8]. Research in reproductive biology is essential for understanding genetic variation and evolution. Many plant seeds undergo chemical inhibiting mechanisms that cause a lower reproduction rate. However, to our knowledge, this is the first report highlighting the natural germination behaviour of *Fagonia indica* seeds.

The mature fruits of *Fagonia indica* containing seeds were collected from their native habitat during two separate seasons (January 2020 and January 2021), from heights Piliv region (Latitude 17°40′02.0″N and Longitude 74°54′49.0″E), With an elevation of 624 metres above sea level, in Solapur, Maharashtra, India. The entire *Fagonia indica* plant, along with its fruits, was authenticated from the Index Herbarium of the Botany Department of Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra. The diseased and infected seeds underwent a manual screening and were discarded. The intact and healthy seeds were dried in the air and stored at room temperature of 25±2°C. The weight of the 100 intact seeds was measured.

The collected seeds were sown at a depth of 1 cm in seed trays filled with coca-beat soil (Garden Booster, Hindustan Biotech, Maharashtra). A total of 376 seeds were sown throughout the year, including winter, summer, and rainy seasons, in a greenhouse located in the climate of Aurangabad city, Maharashtra.

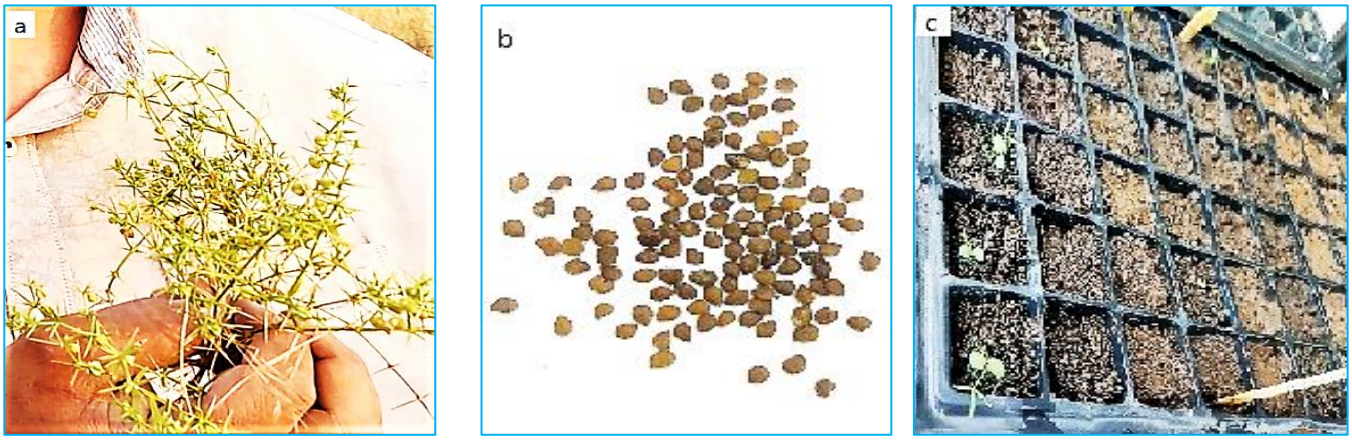

Fig 1 (a) Entire plant of *F. indica,* (b) Seeds of *F. indica*, (c) Plantlet of *F. indica*

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The weight of 100 seeds of *Fagonia indica* was 206 mg. In general, the germination of *Fagonia indica* seeds was 30 out of 376, representing a percentage of 8.0%. The present study examined the influence of two parameters, namely season and dormancy, on the germination process. Based on the seasons as a parameter, there is a significant difference between seasons in germination. The germination rate varied depending on the season, as the germination rate during the rainy season reached its peak at 12.4% Compared with other seasons. The lowest germination was 2.9% in the winter season. On the other hand, the plantlet initiation took more days in the summer and rainy seasons, 11.0 and 12.3, respectively, compared with the winter season, which took three days (Fig 2). The germination process of *Fagonia indica* is influenced by seasonal variations, with the highest germination rates occurring during the rainy season. Additionally, the time required for plantlet initiation differs among seasons, being longer in the summer and rainy seasons compared to the winter season.

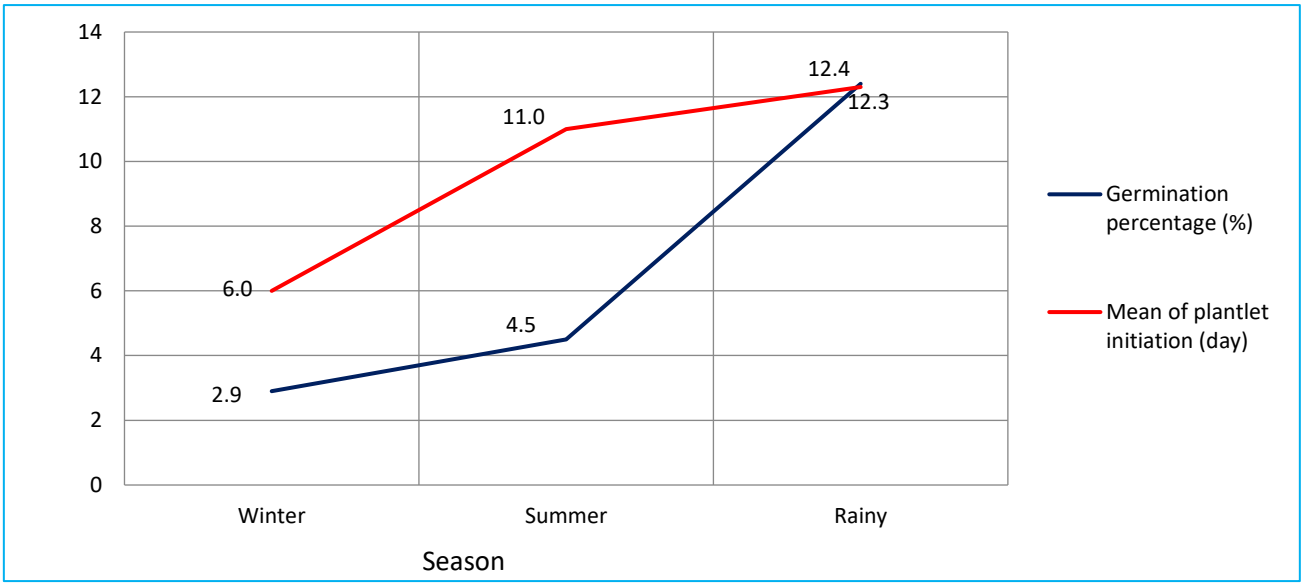

Fig 2 Effect of season on germination and plantlet initiation day

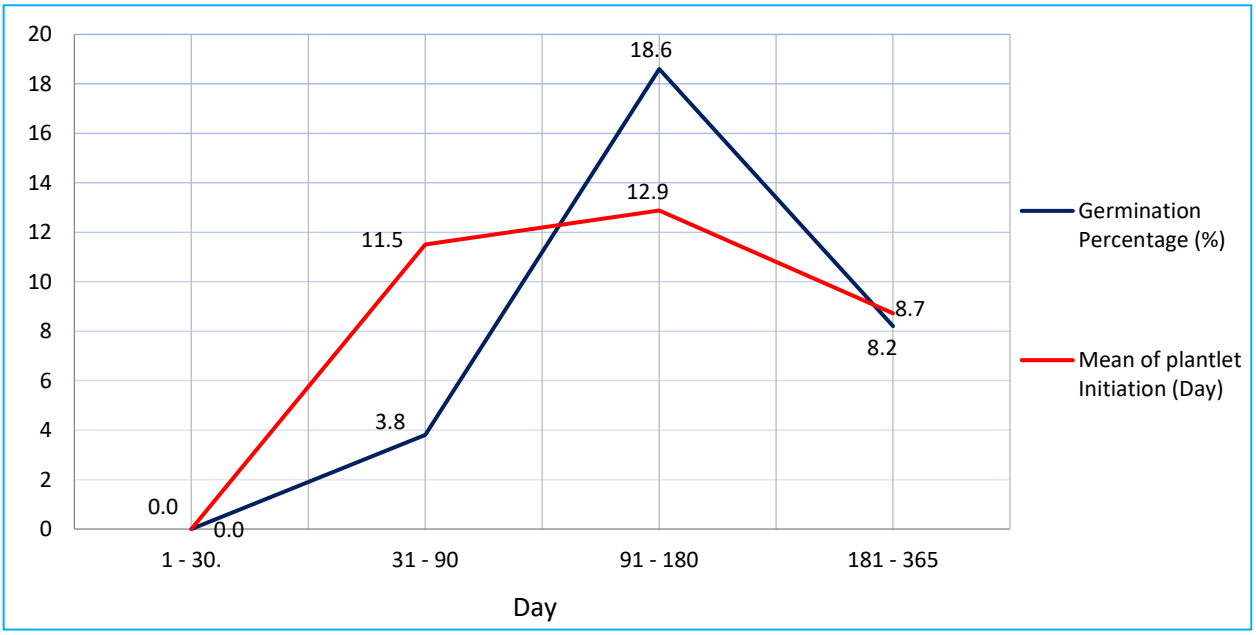

Fig 3 Effect of dormancy on plantlet initiation

Regarding the dormancy parameter, seeds were sown at four different ages to investigate the effect of seed dormancy on germination. There was a significant difference between intervals. The highest germination rate was 18.6% in the interval 90 -180 days. There is no germination in the interval 1 – 30 days; which means, the seeds sown directly did not exhibit any germination. Notably, the rate of germination decreased in the interval 181 – 365 days. Regarding the effect of dormancy intervals on plantlet initiation, there was no significant difference between all intervals except the first one as no germination at all. However, the seeds aged between 181 and 360 days took less time (8.7 days) compared to two of the other periods (Fig 3).

The seeds sown in the rainy season achieved the highest germination rate. It may be attributed to favourable climatic conditions, including abundant rainfall, lower temperatures, overcast skies, and elevated moisture levels. A study conducted by [9] aimed to discover the reproductive mechanism and behavioural patterns of insects on *F. indica*, a plant species native to Pakistan. [10] demonstrated that the reproductive capacity of *Fagonia indica* was much higher than that of *Senna holosericea*. The reproductive effort of *Fagonia indica* was

substantially higher than that of *S. holosericea*. The current study revealed that the seeds germinated of *Fagonia indica* during the summer season (35-40°C) got a low germination rate (4.5%), although *Fagonia indica* is classed as a xerophytic plant. It might be attributed to that the germination of xerophytic plant seeds requires different circumstances compared to those required by adult plants. Abnormally, the plantlet initiation period of germination in winter (6%) was less than the rate in the rainy season (12.3%); this means that cold has a relationship with accelerating the germination process in the *Fagonia indica*. The dormancy parameter showed a significant effect on the seed germination where it occupied the seeds that rested between 90 -180 days with a highest germination rate (18.6 %), while the seeds that rested between 1 and -30 days did not achieve any germination.

SUMMARY

Fagonia indica is a precious medicinal plant. It is distributed in very limited areas of Maharashtra due to an inability to adapt, leading to a decrease in dispersal being the xerophytic plant. This is the first report to address ex-vitro seed germination. In the present study, seeds were planted at a depth of 1 cm in seed trays filled with coca-beat soil. The sown process was carried out monthly during 2020 and 2021. Only 30 of 376 seeds of *F. indica* germinated (8.0%). Depending on the seasons as a parameter, the highest germination rate was 12.4% during the rainy season compared to other seasons. It was attributed to the heavy rain, cloudy skies, and high moisture. Although the rainy season provides favourite conditions for fast germination, however, the period required for the germination of plantlets of *Fagonia indica* during the same season and summer season were 12.3 and 11.0 days respectively; while the winter season was shorter, lasting only 6 days. The other parameter addressed was the dormancy period and its effect on seed germination as the year (365 days) was divided into four periods. The third period (90 to 180 days) achieved a higher seed germination rate (18.6%) compared with other periods. There is no significant difference in the germination time of plantlets across the different periods. The natural germination behaviour of *Fagonia indica* showed more ability to germinate in the rainy season compared with winter or summer. The seeds of *F. indica* gave the highest germination rate by seeds that rested between 90 to 180 days.

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