

existing indexes like per capita availability, per capita production as shown in Table 4. Among the states, Punjab is leading the country in terms of per capita milk availability followed by Haryana and Rajasthan and their rank based on matrix is 8th, 9th and 4th respectively. In addition, the index is dynamic in which parameters can be modified according to requirement and variations in the local conditions and demands. Thus, new Dairy Index is an important aid in understanding the heterogeneity and complexity of the nation's performance in dairy. It is the first attempt at establishing an annual systematic tool for measurement of performance across states and UTs on a variety of dairy parameters within a composite measure.

To conclude, this study has introduced a novel index to better evaluate the dairy development using AHP that can be used by different stake holders for evaluating efficiency of existing systems, etc. The composite Dairy Index can promote a cooperative and competitive spirit among the states and UTs to rapidly bring about transformative action in achieving the desired outcomes. The same can be utilized over a period of years to capture the annual incremental progress on a variety of indicators. Though with the addition

of more criteria, availability of more research information and technologies, the ranking of states could change with subsequent change in the inputs and improving the quantum and quality of data. Future studies can be conducted to standardize the model at the national level and explore its dimensions in evaluating, planning and implementing of various programmes.

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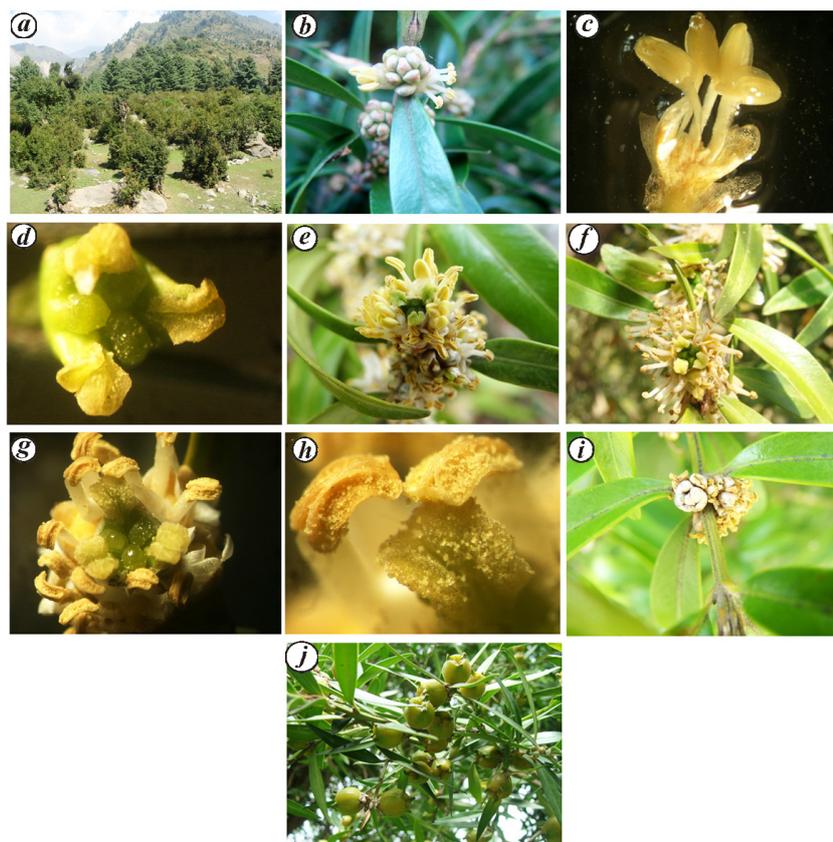
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## Selfing in *Buxus wallichiana* Baill.: a trait or strategy?

Plants of *Buxus wallichiana* are evergreen trees<sup>1,2</sup>; these are monoecious with male and female flowers aggregated together in a cyathium. In each inflorescence, a centrally placed female flower remains surrounded by 8–14 male flowers (Figure 1a, b). Individual male flower is small, incomplete, zygomorphic and averages 5 mm in size. It consists of 4 basifixed anthers enclosed within 5 tepals (Figure 1c). Female flower is slightly smaller than males and has an average size of 4.6 mm. It consists of 5 tepals enclosing a pistil comprising of a tricarpellary ovary and three short styles spread apart with the help of three nectariferous bulges. Each style terminates into bifid stigma (Figure 1d). Ovary is syncarpous, 3 loculed and each locule has ovules attached to a central placenta. Stigma is wet and papillate.

Floral buds appear on the plants in the second week of September when the minimum and maximum temperature in area average 6.8°C and 20.4°C respectively. In October as the temperature lowers to a minimum of 5.4°C, some male flowers (2%) do open and shed pollen, but majority of flowers in an inflorescence including the solitary female flower remain closed (Figure 1b). These flowers then undergo a period of dormancy for 4–5 months (Oct.–Feb./March) when the area of existence experiences heavy snowfall, with temperature dipping to an average of 3.8°C. These conditions prevail till the second week of March. Buds resume opening in the first week of April (average temperature 17.2°C). The male flowers open first indicating protandry. An individual male flower takes one day to expand its tepals

thereby exposing the anthers that elongate their filaments (Figure 1e). On day 3 of anthesis, anther dehiscence initiates. Simultaneously, the remaining male flowers also start opening. On day 6 of anthesis in an inflorescence, female flower initiates opening along with the remaining 2–3 male flowers surrounding it (Figure 1f). Two lobes of each stigma keep appressed to each other till the female flower is closed. As the tepals expand completely, stigmatic lobes also start diverging. These take 2–3 days to expand completely. Anthers of the male flowers surrounding this female flower elongate by day 8, by this time the female flower is also completely open and the stigmatic lobes are spread. On day 9 anthers of the opened male flowers surrounding the female flower are positioned almost above stigma lobes, where



**Figure 1.** *a*, A view of the populations of *Buxus wallichiana*; *b*, An inflorescence with peripheral male flowers opened and centrally female flower as well as some male flowers closed; *c*, A single male flower; *d*, Female flower showing short styles, exposed stigma and nectariferous bulges; *e*, An inflorescence consisting of central female flower opened, peripheral male flowers with dehiscent anthers and central male flowers opened; *f*, An inflorescence consisting of fully opened female flower surrounded by male flowers with dehiscent anthers; *g*, Central male flowers with dehiscent anthers lying above the stigma; *h*, Dehiscent anthers depositing pollen on one of the stigmatic lobes; *i*, A cyathium in dormant condition; *j*, Mature fruit with three persistent styles.

they dehisce (Figure 1 *g*, *h*). Dehiscence is by longitudinal slit. Pollen gets released from the anthers within 30 min of the dehiscence and it is seen directly deposited on the stigma. Maximum pollen load and stigma receptivity were observed on day 5 of anthesis of female flower when the average pollen load and percentage germination were found to be 88.75 and 29.26 respectively.

An interesting feature depicted by plants of this population is that 35–40% of the inflorescences remain closed even after the dormancy period is over. They seem to be suppressed. These inflorescences dry out without setting any seed (Figure 1 *i*). Fruits are set only by the inflorescences that open as a whole. As such fruit set in open fields averages

60.31% (Figure 1 *j*). Average seed set on open pollination is high and it averages  $89.49\% \pm 1.3$  (50–100). Bagging of single inflorescence (in which 4–5 male flowers had initiated opening) in 35 different trees resulted in 100% fruit set revealing thereby that the species is geitonogamous. Seed set in these fruits averages  $63.88\% \pm 2.53$  (50–100). No fruit is set in the emasculated and bagged inflorescences ruling out apomixis for the species.

Although *B. wallichiana* is monoecious, the occurrence of female flower amidst a cluster of 10 male flowers in a compact inflorescence and the direct release of pollen on stigmatic surface create conditions conducive for self-pollination as happens in a homogenous

hermaphrodite flower. That the self-pollen leads to successful fruit and seed set is confirmed by profuse pollen germination on stigmatic surface as well as high fruit and seed set both on open pollination as well as selfing. Almost every opened inflorescence sets fruit. Presence of 100% fruit set in selfed inflorescences reveals that the species is highly self-compatible and predominantly self-pollinated. High degree of self-pollination combined with high fruit set is a rare feature in perennial tree species<sup>3–9</sup>. *B. wallichiana* defies this trend. Whether selfing in the species is a derived feature and somehow related to its endemism needs to be studied out in detail.

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