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Red Gold of Dirang: Monpa Chilli Empowering Monpa Tribes through Food and Livelihood

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The North-Eastern states of India are often called the country's treasure chest of biodiversity and culture. From unique plants and soils to rich agro-ecological zones, and from diverse human communities to rare animal species, this region represents one of India's most vibrant biological and cultural landscapes (Marschke et al., 2005; Berkes et al., 2006). Unlike many other parts of the country, the North-East (NEH region) hosts an extraordinary mix of flora, fauna, climates, food systems and indigenous traditions. Commonly known as the "Seven Sisters" Arunachal Pradesh, Assam, Meghalaya, Tripura, Nagaland, Mizoram and Manipur the region also shares international borders with Bangladesh, Bhutan, Tibet, China and Myanmar, adding to its cultural and ecological richness. With climates ranging from humid tropical valleys to cool temperate highlands, the NEH region is a natural laboratory of diversity. Among these states, Arunachal Pradesh stands out for its high-altitude horticulture and temperate ecosystem. The state's unique climate, stretching from 6,000 ft in Dirang to nearly 15,000 ft near Tawang and Bumla Pass, supports crops that are rarely seen elsewhere in India. Apples, pears, wild blueberries, persimmon, kiwifruit and walnuts are now becoming important livelihood crops for local farmers. The soils here are naturally acidic (pH 4.5–5.5) and the temperature ranges between 0–20°C, creating a perfect niche for temperate fruits and traditional hill farming systems (Singh et al., 2006).

All the tribes of Arunachal Pradesh are of Mongoloid origin and are settled down in different ecological settings and distinct territorial base. Arunachal Pradesh is also a cultural mosaic, home to over 26 major tribes and more than 100 sub-tribes, including the Adi, Apatani, Monpa, Nyishi, Mishmi, Galo, Tagin, Aka, Sherdukpen, Khampti, Wancho, Nocte and Singpho communities. Each tribe brings with it a distinct identity, language, food culture and farming wisdom. Among them, the Monpa (Monpa is used to address the people living in south of Tibet) tribe of West Kameng and Tawang is especially known for its deep connection with temperate horticulture and mountain agriculture. Their livelihood is closely linked to farming, animal husbandry and agro-tourism. Traditional Yak rearing, and products like yak churpi (hard cheese), along with the legendary Monpa chilli, have been part of their culture for more than a century. From sacred mountains to ancient food traditions, from native orchards to age-old eco-friendly practices, the North-East is not just a region it is a living heritage of nature, knowledge and resilience.

The Monpa community has long been involved in both internal and external trade. Traditionally, they followed a well-organized barter system not only among neighbouring tribes but also with non-tribal groups in Assam. Traders from the Kalaktang region often travelled to the Udalguri market in Darrang district, where they exchanged or sold items such as dried Monpa chillies, local maize, khum rice, Ara (traditional liquor), livestock, pepper, and various vegetables. In return, they brought back goods like silk and cotton yarn, clothing, utensils, and other household items (Singh et al., 2004).

Monpa Chilli (*Capsicum* sp.) continues to play a vital role in the daily life of the Monpa tribes. Morphologically, it resembles paprika chilli, though it is not identical. This chilli variety has adapted over many years to the high altitudes of Arunachal Pradesh, and it also performs well in the plains of India. Monpa chilli is primarily cultivated by the three sub-groups of the Monpa community: Northern Monpa (Tawang), Central Monpa (Dirang), and Southern Monpa (Kalaktang region). Among all three groups, it has gained popularity due to its cultural acceptance and traditional food habits. There is noticeable diversity in fruit shape and size among the different regions.

However, with modernization and the introduction of other Indian chilli varieties and hybrids, the purity of Monpa chilli has been declining. Cross-

variability has resulted in a significant loss of genetic purity, especially in West Kameng. There is an urgent need to conserve this unique landrace, and Geographical Indication (GI) registration is one of the most scientific and effective ways to protect Monpa chilli for future generations of the Monpa community.

Monpa chilli exhibits an annual to biennial growth habit and is highly adapted to high altitudes and acidic soils. The fruits are mildly to moderately pungent, but they are exceptionally rich in red pigments such as capsanthin and capsaicin. This chilli performs well not only in the high-altitude regions of Arunachal Pradesh but also under low-temperature conditions in other parts of India. ICAR–Central Institute of Temperate Horticulture, Regional Station, Dirang (West Kameng, Arunachal Pradesh) has been working on the GI registration and DUS characterization of Monpa chilli since 2020. To identify its unique traits, Monpa chilli is being evaluated across four major chilli-growing states of India: Karnataka, Nagaland, Odisha, and Meghalaya.

Some of the distinguishing characteristics of Monpa chilli

- Biennial growth habit
- Purple pigmentation at nodal regions and calyx
- White, large flowers similar to Capsicum annuum, with fused petals
- Purple to bluish anthers at the bud stage (one day before anthesis)
- Inserted stigma inside the anther cone, restricting natural cross-pollination

Monpa Chilli Diversity: A single landrace, many shapes and sizes

These traits, repeatedly observed over two seasons in Dirang and other evaluation sites, clearly differentiate Monpa chilli from other GI-protected chillies like Naga chilli and Mizo chilli.

Monpa chilli is highly susceptible to Cercospora leaf spot and thrips during the summer months, although the incidence is considerably lower in winter.

Based on traditional knowledge of the Monpa community, sowing is carried out from March to June, while harvesting begins in August and continues until November–December for both fresh consumption and drying. The fruits are small to medium in size, initially deep green, turning pinkish-blue at the intermediate stage, and finally developing a deep red colour when fully ripe. The fruiting habit is pendulous, and a high pollen load has been consistently recorded during anthesis in two consecutive seasons at ICAR-CITH, Dirang. At full maturity, the fruits exhibit a wrinkled and curled pericarp, similar to Guntur and Kashmir chillies commonly used for red chilli powder production. Most Monpa farmers, particularly rural women, continue to use traditional seed-saving practices, carrying forward seeds from one season to the next. Because Monpa chilli has an inserted stigma that largely restricts cross-pollination and favours self-pollination or very limited accidental cross-pollination, genetic purity has been relatively well maintained over generations. This characteristic makes it possible to identify and conserve the true indigenous Monpa landrace through selfing and fixation of original traits.

Future breeding strategies should focus on the selection and evaluation of superior Monpa breeding lines, with comparison against national and state check varieties to improve yield and adaptability. Introgression of resistance genes against Cercospora leaf spot and incorporation of high-yield meta-QTLs should be prioritized as key breeding objectives. Establishing a defined geographical area for Monpa chilli cultivation, along with characterization of desirable agronomic and quality traits, will support long-term conservation and utilization. Formation of Farmer Producer Organizations (FPOs) and expansion of large-scale production for value-added products such as red chilli powder would significantly benefit the Monpa community. Strong institutional and government support is essential to achieve these goals, along with GI registration to secure the crop's cultural and commercial identity.

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