REPORT

URGINEA INDICA – IMPORTANCE AND NEED FOR AWARENESS

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Abstract: *Urginea indica* (Roxb.) Kunth. is a bulbous perennial herb belonging to family Liliaceae. The species is distributed abundantly on Rocky Mountains and on dry sandy soils near the sea. It is also found growing in J & K in different habitats. The bulbs are of immense medicinal importance and used in the treatments of many ailments, though locals of J & K consider them as a best remedy for joint pains and for removing thorns. While extensive literature is available on its phytochemistry, tissue culture, taxonomy and systematic, little is known about its cytology, reproductive biology, breeding system and genetics. The species is increasingly becoming threatened in few regions due to non-awareness and habitat degradation. The present communication attempts to bring forth the amount of work already done on the species and its importance. It is aimed to motivate the researchers and explorers to undertake more work on the species before it is lost to ruthless traders and urbanization.

Keywords: Bulbs, Diploid, Morphological variants, Phytochemicals, Polyploidy, *Urginea indica*

INTRODUCTION

Urginea Steinhill belonging to family Liliaceae is a large polytypic genus of bulbous herbs. Represented by about 100 species, it is endemic to India, Africa and Mediterranean region (Airy Shaw, 1993). Of the 100, 9 species are found in India (Hamidri and Sasibhushan, 1982), two of which namely *U. maritima* Baker (European or Red squill) and *U. indica* (Roxb.) Kunth (Indian or White squill) are medicinally important (Anonymous, 1976). *U. indica*, a native of India and Burma (Singh and Dey, 2005), is distributed abundantly in north-western Himalayas upto 2000 ft and extends to South-India, Konkan, Coromandal and Bihar (Jain, 1968). Also found in Western Peninsula and Tropical Africa (Kritikar and Basu, 1935), it frequently grows in dry sandy soils near the sea (Anonymous, 1976). In J&K, the authors have located populations of this species in Kalakupar (near Nandini tunnel, District Jammu) as reported by Sharma and Kachroo (1981) and villages Galakh and Lakhri of Tehsil Billawar (District Kathua).

Drimia indica (Roxb.) Jessop has been regarded as its synonym (Jadhav, 2008). The species under consideration i.e., *Urginea indica* is also known by different regional names like 'Jangli piyaz' (Hindi), 'Banpiyaaj' (Bengali), 'Janglikando' (Gujrati), 'Rankando' (Marathi), 'Kolokanda' (Sanskrit), 'Narivengayam' (Tamil), 'Nakkavalligadda' (Telugu) and 'Banganda' in Dogri (Jain, 1968; Sharma and Kachroo, 1981). Maximum published work on this species pertains to phytochemistry, cytology, tissue culture, taxonomy and systematics. Major contributors from across the world are: Raghavan and Venkatasubban, 1940a,b; Jha and Sen along with their co-workers (1981, 1982, 1983, 1984, 1987 and 1990); Shivakameshwari with her co-workers (1999, 2004, 2011, 2012); Oyewole and Mustapha (2000). Of these, two Indian groups have substantial contributions and deserve special mention. These are Jha (1989), Jha and Sen (1981, 1982, 1983, 1984, 1987 and 1990) and Shivakameshwari with her associates (1999, 2004, 2011 and 2012). These works largely pertain to cytology, phytochemical analysis, tissue culture and systematics. Reproductive biology of the species is neither known nor worked out in detail except for a single report of the species being self-compatible and cross pollinated by insects (Shivakameshwari *et al*, 2012).

The bulbs of *U. indica* are of immense medicinal importance. Known to possess anthelmintic, stimulant, deobstruent, digestive, diuretic, emmenagogue, expectorant and laxative properties (http://www.impgc.com), these are used for curing snake bites, goitre in cattle, relieving pain after delivery (Singh and Khan, 1989), removing warts and corns, treating chronic Bright's disease (a typical degeneration of kidneys), scabies, rheumatism (http://www.divineremedies.com), skin ailments (Sultana *et. al*, 2010), psoriasis (Shivakameshwari *et al.*, 2012), strangury and fever in horses, burning sensation in soles of feet (Drury, 1978), parched tongue, fevered lips and contraction of features (Shivakameshwari, 2013). The plant is also known to possess cardio-tonic, anti-tumor and anti-cancer properties (Deepak and Salimath, 2006; http://www.ewtc.cn). The alcohol extracts of the bulbs have high anti-inflammatory, good anti-arthritic activity and moderately good analgesic effects (Rahman *et al.*, 2011). Different solvent extracts have antimicrobial activity against the bacterial strains and fungus (Rathabai *et al.*, 2012). The locals of J&K (India) consider it to be the best remedy for joint pains and for removing thorns. In large doses, it acts as an acrid poison inducing nausea and active movement of bowels (http://www.divineremedies.com) and a narcotic (http://www.ewtc.cn).

Detailed phytochemical analyses have been conducted on the bulbs of *U. indica* by many workers (Table 1). Time and quantity of production of some of these phytochemicals vary with the ploidy level and developmental stages of the plants. Some also show seasonal variation (Jha and Sen, 1981a, b; Jha and Sen, 1982; Patil and Torne, 1980). For example, stigmasterol, the principal sterol, is found in all the organs (root, leaves and bulbs) of all the cytotypes. Bufadienolides like proscillaridin A and scillaren A, on the other hand, are found only in roots of all the cytotypes. Tetraploids, in addition to these, also contain scilliphaeoside and anhydroscilliphaeosidin, and triploids, scilliphaeoside. Proscillaridin A and scillaren A show seasonal variation reaching a maximum twice in the annual cycle, once at the peak of their vegetative phase and second at the end of dormancy phase (Jha and Sen, 1982). Similar is the case of scilliphaeoside in tetraploids. This decrease prior, during and after flowering has been attributed to its gradual utilization (Jha and Sen, 1982). Kopp *et al.* (1996) isolated 13 bufadienolides from *U. indica* and 41 from *U. maritima*.

The cardioactive glycoside present in squill (Lewis and Lewis, 1977) resembles that of *Digitalis*. This cardioactive is recommended only in those patients who need to be treated with *Digitalis* but are hypersensitive to that drug (Jain, 1968; Anonymous, 1976). Found to vary seasonally, these compounds also reach a maximum at the start of the dormancy period i.e., in October (Patil and Torne, 1980).

A 29 KDa glycoprotein isolated from the bulbs of *U. indica* has antifungal (Deepak *et al.*, 2003; Shenoy *et al.*, 2006) and anti-tumor activities (Deepak and Salimath, 2006). Possessing a significant homology to class II chitinases of glycoside hydrolase family 19, it gives tolerance against fungal pathogens such as *Fusarium oxysporum* and *Rhizoctonia solanii* (Shenoy *et al.*, 2006). Three novel flavonoid glycosides also isolated from the bulbs (Sultana *et al.*, 2010) have been added to the existing list. *U. maritima* also contain three bitter glucosidal substances Scillitoxin, Scillipicrin and Scillin; Sinistrin, an inulin-like substance; mucilaginous and saccharine matter and calcium oxalate crystals (http://www.botanical.com). Raphids (calcium oxalate crystals) are also present in vegetative and reproductive parts of *U. indica* and play a vital role in protecting plants from herbivore attack. The bundle size of raphids varies considerably within the species which suggests their potential to be used as a taxonomic tool (Prathima Rao *et al.*, 2012).

Voluminous literature is available on the cytology of *U. indica* (Fedorov, 1969; Raghavan and Venkatasubban, 1940a, b; Sen, 1974; Jha and Sen, 1983a,b; Shivakameshwari and Muniyamma, 2004). With its diploid number being 2n=20 (Fedorov, 1969; Raghavan and Venkatasubban, 1940a; Sen, 1974; Jha and Sen, 1983a), the species is known to exist in several cytotypes. Tripolids, tetraploids, hexaploids and aneuploids (Raghavan and Venkatasubban, 1940b; Jha and Sen, 1983b; Shivakameshwari and Muniyamma, 2004) along with B-chromosomes in some diploid races (Sen, 1974) are on record.

In diploid plants, chromosomal fragments varying in number are found in the somatic and meiotic cells of the same individual (Raghavan and Venkatasubban, 1940a). The somatic complement is characterized by two typical chromosomes; C_1 and C_2. The former bears a secondary constriction at its distal end while the latter has a terminal constriction and a satellite at its proximal end. The two are distinct from the rest and break easily; their satellites forming persistent fragments. Fusion of gametes with such fragments leads to the formation of individuals with varying number of these bodies. Further work by Raghavan and Venkatasubban (1940b) led to the isolation of triploids from a heterogenous population which differ from diploids in having much longer scapes.

Of the 20 populations collected by Jha and Sen (1983a), nine turned out diploid and rest polyploid (Jha and Sen, 1983b). Plants of all the diploid populations uniformly had 2n = 20 chromosomes. Only one carried B-chromosomes in addition to the normal 20 (Jha and Sen, 1983a). Interestingly however, all polyploid populations were devoid of B-chromosomes (Jha and Sen, 1983b). On the whole, karyotypic variation is quite high at the inter-population level. On the basis of their relative length and position of primary and secondary constrictions chromosomes were divided into different groups. Present in different combinations in different cytotypes (Jha and Sen, 1983a, b), the plants were collected from various areas within a broad climatic zone. Inter-population karyotypic variation was, therefore, attributed largely to the presence of cytotypes in different microclimatic conditions. Role of structural alterations was also not ruled out. Surprisingly, heteromorphicity prevalent in non-nucleolar chromosomes does not manifest in their pairing ability during meiosis (Jha and Sen, 1983a, b).

These cytotypes of *U. indica* enjoy wide distribution in India; diploids found throughout, triploids restricted to the peninsular part including the southern and western belt, and tetraploids in the southern coast. The cytological races across this distributional range are maintained by extensive vegetative reproduction (Jha and Sen, 1983b).

As mentioned before, only diploids of *U. indica* are known to have B-chromosomes in their cells (Sen, 1974). Their presence in all the individuals of a population is indicative of some adaptive advantage being provided to the population concerned. B-chromosomes are absent in tetraploids probably because they have a high tolerance range on account of higher ploidy and therefore donot require any accessories. It is worthwhile to mention that cytotypes with B-chromosomes also exhibited polysomaty (Jha and Sen, 1984). That is, cells with different ploidy levels (diploid, hyperdiploid, hypertriploid and hypertetraploid) are noticed in a single root tip, but the B-chromosomes are invariably recorded only in those with 2n = 20. Their number varies from cell to cell with 6 being the modal number. Notwithstanding this numerical variation, B-chromosomes are uniformly metacentric and small with subterminal primary constriction.

Plants of *U. indica* with varied ploidy states have also been reported by Shivakameshwari and Muniyamma (1999a, 2004). Diploid (2n=20), triploid (2n=30), tetraploid (2n=40), hexaploid (2n=60) and aneuploid populations have been recorded with plants having 2n=32, 34, 36, 38 and 46 chromosomes. Aneuploidy in *U. indica* as per Shivakameshwari (2004) might have originated as a result of hybridization between polyploid taxa and, the individuals formed must have perpetuated through efficient vegetative propagation. An aneuploid of the sister species, *U. polyphylla* having 2n=54 is also on record (Shivakameshwari and Muniyamma, 1999b). Its bulbs are found to have a number of bulbils adhered to them; each giving rise to a new plant.

Jha *et al.* (1984) tried *in-vitro* regeneration of *U. indica* on modified MS basal medium using 3-5 scales joined at the base by a small piece of disc, individual scales and axial discs as explants. Of the three, only the first responded to culture conditions and formed bulblets. These *in-vitro* regenerated bulblets were then used as a source of secondary explants. Approximately 400 bulblets formed in liquid culture exhibited 90% survival when transferred to potted soil. This method of regenerating plants from secondary explants proved advantageous and rapid. Calli obtained from bulb scales showed significant cytological changes during regeneration (Jha and Sen, 1987). Organogenesis like formation of shoots and roots occurred when the calli were 8-10 week old. Cytological analysis of the calli revealed the cells to be normal diploids. But with the increasing age of calli, polyploidy increased, and increasing cytological abnormality led to a drastic decline and finally loss in their potential to undergo organogenesis (Jha and Sen, 1987). Bulb scale explants from diploid plants formed friable calli which gave rise to embryonic calli when allowed to remain on 2, 4-D for a prolonged period (Jha, 1989). Calli obtained from explants raised on different media show different levels of karyological heterogeneity, being lowest with NAA and highest with 2, 4-D alone (Jha and Sen, 1990). Bulblets regenerated *in-vitro* produce bufadienolides-Proscillaridin A and Scillarin A, characteristic of the parent plant (Jha *et al.*, 1991).

Systematics of the species has been worked out by different workers (Oyewole, 1987a,b; Mustapha, 1996, 1997, 1999, 2000a,b; Oyewole and Mustapha, 2000). According to them, *U. indica* is a species complex comprising of different morphological variants which are reproductively isolated from each other (Oyewole, 1987a,b). The forms which vary in vegetative and floral morphology as well as anatomy occur in different ecological niches and their distribution is affected by three important factors of the environment-weather, temperature and soil (Mustapha, 1996, 1997). Chromosome morphometry of these forms also differs but differentiation at the morphological level is pronounced than that at the cytological level suggesting that chromosome repatterning may have been mild. This taxon, therefore, comprises a stable polymorphism in which different forms have attained genetic stability and each form has retained its morphological identity (Mustapha, 2000b). Hybridization between groups of the complex was unsuccessful indicating their reproductive and genetic isolation from one another. These results, further, established the fact that each form is a distinct genetic system related to but different from the other (Mustapha, 2009). This indicates that the complex comprising normal plants and variants is in a dynamic state of evolution. The taxon, thus, represents a stable polymorphism in which different forms have attained some amount of genetic stability and each form has retained its morphological identity (Mustapha, 2000b). Based on their detailed morphological, ecological and cytological analyses, therefore, Oyewole and Mustapha (2000) proposed the division of *U. indica* complex into three subspecies- *U. indica indica*, *U. indica augustifolia* and *U. indica tenuifolia*.

A new species of *Urginea*, *U. nana* from Nigeria (Oyewole, 1989) differs considerably from *U. indica* in morphology and meiotic behaviour. In *U. nana* a dicentric bridge is formed at anaphase-II. It is probably on account of this difference that Mustapha (1999) speculates *U. nana* to be a hybrid, parents of which have not been identified.

Differences in micromorphological features of the epidermis have been reported and considered taxonomic in significance (Shivakameshwari, 2011). These features may help in according a sub-specific status to the populations of *U. indica*.

U. indica is threatened in few regions due to non-awareness and habitat degradation (Shivakameshwari *et al.*, 2012). One of the populations of J&K growing in Kalakupar has also been completely destroyed due to NSEW corridor project under National Highway Development Programme which involves widening of NH-1A from Jammu to Srinagar. Not only the natural habitat but the germplasm as well is lost forever. Whatever could be saved has been saved by the authors and is safe in the Botanical Garden of University of Jammu. But this is in no way a substitution for the natural populations.

The bulbs found in coastal sand dunes are enriched with arbuscular mycorrhizal fungal species. These arbuscular mycorrhizal fungal species have the potential to stabilize the disturbed habitats and help in conservation of vulnerable species of *U. indica* (Kamble *et al.*, 2012). Studies of this sort are not available for J & K. This calls for an indepth study and a means to regenerate the species in habitats similar to Kalakupar in J. & K. We, therefore, through this communication wish to motivate researchers and explorers to undertake more work on the species before it is lost to ruthless traders and urbanization.

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