results indicated that there is a great diversity for blast resistance in the native O. rufipogon populations. Since the northwestern Himalayan region is one of the centres of diversity for Oryza spp., a prolonged co-evolution of host–pathogen coupled with mixed mating system of wild rice 5, has probably enhanced the diversity for resistance in the native wild rice populations. The present data also indicate that some wild rice varieties share common resistance specificities with cultivated rice varieties. For example, all the accessions in cluster VI, including cultivated rice genotypes, Palmdhan-957 and Himdhan, shared common resistance specificities to pathogen isolates Pg2, Pg3, Pg6, Pg8 and Pg10. Likewise, all the accessions in cluster VII, that also includes rice cultivars HPU-741 and Himalaya-2, shared resistance specificities to isolates Pg2, Pg4 and Pg9. These common specificities could either be the result of recent transfer from cultivated to wild types or might be the relics of ancient diversity that existed in cultivated rice since its domestication from wild rice. Nevertheless, wild rice germplasm represents a potential source of new blast-resistance specificities for broadening the genetic base for blast-resistance in rice. For example, wild rice accessions WRA-18 and WRA-21 exhibited broad resistance spectrum to all the isolates tested, including Pg-1 that infects all the cultivated rice genotypes tested. Since O. rufipogon with AA genome is sexually compatible with cultivated rice, these two accessions can be used as potential donors of easily transferrable blast resistance in rice breeding programmes. Further investigations on type of gene action and allelic relationship of these resistance sources with already known blast resistance genes that are highly effective against blast population of HP are urgently needed 10.


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Rapidly in vitro multiplied Drosera as reliable source for plumbagin bioprospection

Drosera (Droseraceae) is the largest group of insectivorous plants. It comprises of 170 species and is cosmopolitan. All species of Drosera contain plumbagin (5-hydroxy-2-methyl-1,4-naphthoquinones) or ramentaneone (7-methyljuglone) or both 1,2,5. Plumbagin exhibits a variety of therapeutic functions such as anti-microbial, anti-tuberculosis, bronchial infection, whooping cough, anti-asthma, antisepsic, anti-cancer, enhances in vitro phagocytosis of human granulocytes, antileprosy, antifebrility, abortifacient, chitin synthetase inhibitor, immunomodulator, cosmetic, aphrodisiac, used against old age, arteriosclerosis, extract used in certain sweets, antifeedant, anti-malarial, hyperglycaemic and other properties 3,5,6. In European countries, Droseras is included in pharmacopoeias and dried plants are marketed as ‘Herba Droserae, Herba Drosera rotundifoliae’ which is difficult to obtain from natural habitat. Hence, Drosera from the southern hemisphere, such as D. indica, D. burmanii, D. peltata, D. ramentacea and D. madagascariensis is being exported to European countries 7. In India D. indica L., D. burmanii Vahl, and D. peltata J.E. Sm. ex Willd have been reported from different parts. They are used as vital components in an Ayurvedic preparation called ‘Swarnabhastma’ (Golden ash). Macerated D. indica is used to remove corns and has been categorized under vulnerable medicinal plants 8,9.

We have collected D. indica and D. burmanii from the following locations in Andhra Pradesh (district name mentioned in parenthesis) Gachibowli (Ranga Reddy), Narsapur (Medak), Anjodigadda (Visakhapatnam), Talakona (Chittoor), Tada (Nellore), Mulakamaru (Khammangan), Kondaparthi (Warangal); D. indica: Chelvay (Warangal); Punchamadalu (Kurnool); Arakuvally (Visakhapatnam), Pakhal lake (Warangal); Sirisailam (Kurnool), and D. burmanii: Motugudem (Khammam); Tirumala (Chittoor). Eriocaulon, Urticaria and Sphagnum were the associated species in most of the investigated locations. The microhabitat in all these locations comprises wet slopes and poorly drained rocky outcrops with sand and clay soils, often with moss and peat. Urbanization, drought, agricultural pollutants, soil erosion, habitat conversion and fragmentation are the primary causes of threat.

We initiated research on Drosera as part of ex situ conservation and established in vitro protocols for rapid multiplication. Shoots of D. indica and D. burmanii were cultured on MS basal medium with 3% sucrose, 0.3% agar at pH 5.7. The

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cultures were maintained at 25 ± 2°C and 16/8 h photoperiod with a light intensity of 30 μEm⁻² s⁻¹. D. indica profusely produced multiple shoots on MS medium supplemented with 0.5 mg l⁻¹ KN, Z and 0.1 mg l⁻¹ BAP. Rooting was successfully observed on MS basal medium (Figure 1 a and b). In D. burmannii, production of large number of multiple shoots was achieved with 2.0 mg l⁻¹ KN and 1.0 mg l⁻¹ BAP. Regeneration of plantlets from the peduncle was also observed on lower concentrations of KN (≤1.0 mg l⁻¹), which were also used as explants for regeneration of multiple shoots. Rooting was successfully observed on MS basal medium (Figure 1 c and d). Both the species exhibited retarded growth at higher concentrations of cytokinins. However, they regained normal growth when transferred to MS basal medium or the medium with lower concentrations of cytokinins. In case of D. burmannii, direct plantlet regeneration was achieved from leaves after transferring of growth-retarded explants to MS basal or lower concentrations of cytokinins. These results report rapid in vitro multiplication of D. indica and D. burmannii. Reintroduction of in vitro produced plants to natural habitat was not satisfactory, in spite of transfer through simulated assembly of standing pots in trays of water (transit between in vitro and field conditions). Therefore, one of the feasible strategies to utilize this abundantly produced in vitro fresh material of D. indica and D. burmannii, would be bioprospection of plumbagin and other useful metabolites. Further, procurement of large quantities of fresh material from nature would be impossible. Utilization of in vitro produced Drosera would be an alternative viable strategy for production of plumbagin and other invaluable phytochemicals to fetch profitable international market.

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