Establishment and Economic evaluation of micropropagated Jeewanti (Leptadenia reticulata Wight & Arn.) plants in field

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Abstract

Leptadenia reticulata Wight & Arn. is an important medicinal plant. There is heavy demand of the plant and its biomass which can not be fulfilled by the natural/present practices of propagation. Natural propagation of this plant is poor and the plant is threatened in nature. Thus, there is a need for applying biotechnological methods for large scale propagation. Micropropagation studies were carried out by the authors on explants. Multiple shoots were differentiated on Murashige and Skoog’s (MS) medium containing 5.0 mg/litre 6-benzylaminopurine (BAP). The shoots further multiplied on MS medium + 1.5 mg/litre BAP and 0.5 mg/litre kinetin (KN) and the cloned shoots, treated with 200 mg/litre of Indole-3-butyric acid (IBA), rooted ex vitro. The plantlets were transferred to bottles containing soilrite moistened with half-strength MS macro salts. The hardened plants were transferred to polybags and kept in shade house for acclimatization. Subsequently field trials were carried out at villages Manai (Jodhpur) and Kachholi (Sirohi) of Rajasthan. In the present paper establishment of micropropagated plants, cultivation, growth and net profit from biomass produced has been reported for environmental conditions of Rajasthan. Total dry biomass harvested was 2800 kg/acre for first year and 3000 kg/acre for second year.

Keywords: Leptadenia reticulata, Jeewanti, Micropropagation, Medicinal plant, Nodal segments, Ex vitro, Field trials, Economic evaluation.

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Introduction

The World Health Organization has estimated that more than 80% of the world’s population in developing countries depends primarily on herbal medicine for basic healthcare needs. Of the 50,000 species of medicinal plants used, about two-third are collected from the wild. Canter et al suggested promotion of domestic cultivation of medicinal plants as viable long-term alternative. This offers opportunity to optimize yield and achieve uniform quality products. The application of biotechnology to solve inherent problems for medicinal plants has been subject of research and reviews.

Leptadenia reticulata Wight & Arn. (Family — Asclepiadaceae; Hindi — Jeewanti) is used in healthcare and has been known for its medicinal uses since 4500 BC. In Atharva-veda this plant is described as life and strength giver. According to Ayurveda, it is a tonic and gives general strength to the body. The plant is a stimulant and claimed to prevent miscarriage (as life-giver and hence the name Jeewanti). Jeewanti is non-hormonal and non-toxic herbal medicine. It promotes lactation in mammals and is an important ingredient of poultry-feed. The leaves and roots of the plant are used for curing skin diseases, inflammation of the skin and also to heal wounds/burns. The shoots, leaves and follicles of this plant are eaten as a vegetable in the time of scarcity.

Natural propagation is through seeds and destruction of its natural habitat is one of the reasons for poor reproduction and propagation. There is huge demand of the drug hence conservation and commercial cultivation of the species has become essential. Arya et al described micropropagation method and Martin reported its regeneration through somatic embryogenesis from callus culture derived from node and apical shoots. In the present investigation: (i) establishment and cultivation of cloned plants in farmer’s field, (ii) biomass production, and (iii) cost-benefit analysis under environmental conditions of Rajasthan has been studied.

Materials and Methods

The method adopted by Arya et al was further improved and used for establishment of culture of
**L. reticulata.** The nodal shoot segments were harvested from green house-maintained plants. These were surface sterilized with 0.1% (w/v) mercuric chloride for 4-5 minutes and finally dipped in 90% ethanol for 30-40 seconds and washed thoroughly 6-7 times with autoclaved water. These explants were kept in an aqueous solution of chilled antioxidants (100 mg/litre ascorbic and 50mg/litre citric acids) for 20-25 minutes to prevent browning of explants. These were cultured aseptically on MS (Murashige and Skoog) medium containing BAP and KN. The cultures were kept under dark for 2-3 days initially and then transferred to culture room at 26+ 2°C temperature and 36μmol/m^2/s/ SFP for 10 hr/day. The shoots differentiated in culture were multiplied by subculture at an interval of 3 weeks. Further amplification of shoots in culture was done by cultivation of basal shoots clumps on MS medium supplemented with 150 mg/litre ammonium sulphate + 1.5 mg/litre of BAP and 0.5 mg/litre of kinetin.

The shoots differentiated in culture were individually excised and harvested. These were treated with 200 mg/litre of IBA for five minutes and transferred to bottles containing soilrite moistened with one fourth strength of MS macro salts. The culture bottles were kept in the green house for rooting at 30°C. After initiation of rooting under ex vitro conditions; the caps of the bottles were loosened and subsequently removed after 15 days. The hardened plants were transferred to polybags containing 2:1:1 (v/v) ratio of sandy soil, farmyard manure and soilrite and kept in the green house for 30 days and then in shade house (50% shade) for acclimatization prior to field evaluation.

One-year-old micropropagated plants were transferred to field during 2003 and 2004. The field trials of these plants were conducted at villages Manai (Jodhpur) and Kachholi (Sirohi) of Rajasthan. The fields were ploughed and harrowed twice. Farmyard manure (3000 kg/acre) was mixed in the soil. Plant to plant and row to row distances were kept about 100 cm. The plants were transplanted in 30 × 30 cm pits. The pit soils were mixed with 0.5 kg of vermicompost and were irrigated immediately. The subsequent irrigations were given after 3rd and 8th day of transplantation. The fields were irrigated once in a month during winters. During summers these plants were irrigated twice a month. After nine months of transplantation, the first harvesting of biomass was done; subsequent harvestings were done in the last week of May, August and November. The biomass harvested was dried under shade and calculated yield as kilograms of biomass/acre/year.

### Results and Discussion

The plant of *L. reticulata* maintained in green house proved to be suitable source of explants throughout the year. Bud breaking and shoot proliferation occurred on MS medium + 5.0 mg/litre BAP. The shoots were multiplied by subculture on MS medium + 1.5 mg/litre BAP and 0.5mg/litre KN. We further improved upon method of shoot multiplication reported by Arya *et al* by addition of Ammonium sulphate in culture medium that enhanced the number of shoots to 25-30 per vessel. Of the shoots treated with 200mg/litre for 5 minutes, more than 80% rooted in green house. *Ex vitro* rooting is cost effective. This reduces time period of plant production. More than 95% of the tissue culture-raised plants survived in fields. The growth of the plants was slow during winters and hence no harvesting was done. Plants recovered growth in late February and grew vigorously during March. Average dry biomass yields at farmers field was 2800 kg/acre for the first year and 3000 kg/acre for the second year, respectively.

Addition of farmyard manure 3000kg/acre/year is essential for optimum growth of *Jeewanti* plants. The plants developed extensive root system after two years of growth in the fields. It is a perennial woody liana and entire biomass of the plant is of economic value. It is suggested that once planted, this species yields biomass for 10-15 years. Cost benefit of cultivation of micropropagated *Jeewanti*, based on observations and data of two years has been calculated. For the first year, calculated expenditure comes around Rs.61250/acre (including charges for land preparation, plant material, planting manure, irrigation, harvesting, processing, packaging and manpower cost involved in all operations). At the end of the year, 2800 kg/acre of dry biomass was harvested. At the rate of Rs.25/kg, Rs.70000 was generated from the sales of biomass. Thus, for the first year, net profit per acre was Rs. 8750. Subsequently cost of cultivation for the second year was Rs.18250/acre. The dry biomass yield was 3000 kg/acre. Revenue generated was Rs.75000 and hence net profit of Rs.56750/acre. These might change with time, locality of cultivation and environment.
Conclusion

Consumption of herbal medicine is wide-spread in food, feed, health-care and neutraceutical industries. This trend is increasing. Harvest from the wild is creating many problems including (i) loss of valuable germplasm/genetic resources, (ii) improper identification and adulteration and hence harming credibility, and (iii) habitat destruction particularly of fragile ecosystems. Cultivation under management is viable alternative and offers opportunities to win over the inherent constraints of traditional herb-harvesting/extraction. Use of controlled or partially controlled environments can promote efficient, low cost and possibly risk-free cultivation. Application of tissue culture is one of the alternatives for high volume production of selected germplasm ensuring genetic stability and uniformity. This technology can also be used for conservation, storage and safe transportation of threatened and rare germplasm\(^1\). In case of jeewanti very encouraging results have been obtained for sustainable supply of this important herbal drug.

References


