III.3 Eggplant

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1 Introduction

Eggplant (Solanum melongena L.) (2n = 24), commonly known as aubergine, guinea squash or brinjal, is an important vegetable crop of tropical and temperate regions of the world. It is a good source of vitamins and minerals, especially iron, making its total nutritional value comparable with that of tomato (Kalloo 1993). Besides being used as an important vegetable, eggplant has been exploited extensively in traditional medicines (Khan 1979). For example, tissue extracts have been used for the treatment of asthma, bronchitis, cholera and dysuria; fruits and leaves are beneficial in lowering blood cholesterol. Recent studies have shown that eggplants also possess antimutagenic properties. The medicinal and economic value of eggplant can be found in the Sanskrit literature (Khan 1979; Hinata 1986; Kalloo 1993).

Eggplant probably originated from India, with Indo–Burma, China and Japan as the secondary centres of origin (Gleddie et al. 1986a). The plant has been cultivated in Asia for over 1500 years. Arabs introduced this crop to the west during the fifteenth century (Hinata 1986). Germplasm resources and collections have been well documented, evaluated and conserved throughout the world (Sarathbabu et al. 1999). Eggplant has been divided into three main types based on the fruit shape. These include egg-shaped (S. melongena var. esculentum), long and slender in shape (S. melongena var. serpentium) and dwarf types (S. melongena var. depressum; Kalloo 1993).

Various cultivars of eggplant are susceptible to a variety of stress conditions, which limits crop productivity significantly. Plant improvement using conventional breeding methods has been directed towards fruit size, weight and shape, and resistance to diseases and pests (Kalloo 1993). This has led to the development of numerous varieties of eggplant with improved characteristics and yield. There are also many wild species of eggplant that are resistant to pests and pathogens and are the source of agronomically important genes that can be exploited for eggplant improvement (Collonier et al. 2001a; Kashyap et al. 2003). Efforts to impart disease and pest resistance to cultivated varieties have been achieved with only limited success due to sexual incompatibilities with the source species or wild relatives (Daunay and Lester 1988; Kashyap et al. 2003). In addition, introgression of desired traits such as parthenocarpicy,
improved nutritional value and post-harvest qualities into the cultivated varieties is difficult to achieve due to the lack of appropriate sexually compatible varieties or species (Collonier et al. 2001a).

Recent advances in biotechnology and genetic engineering have provided a new impetus to eggplant improvement programs. The development of efficient tissue culture systems for plant regeneration has facilitated rapid multiplication of desired genotypes, while protoplast culture and fusion methods are important for the production of novel somatic hybrids and cybrids, thereby surpassing sexual incompatibility. Genetic engineering enables trans-Kingdom gene transfer, permitting gene introgression and crop improvement at a faster pace through precision breeding. Excellent progress in eggplant research has been made over the past two decades and many transgenics with improved traits have been developed. This chapter reviews the progress in eggplant biotechnology.

2 Tissue Culture

An ability to regenerate plants from cultured cells and tissues at high frequency has been considered as the corner stone of plant biotechnology, as it serves as an alternative means of vegetative propagation and is a pre-requisite for the production of genetically modified crops. In eggplant, plants have been regenerated from somatic cells and tissues, or from anthers and microspores via organogenesis and/or embryogenesis.

2.1 Organogenesis

Cultivated and wild species of eggplant have been regenerated through organogenesis (Fig. 1). Organogenesis has been achieved using various explants (Rao and Narayanaswami 1968; Kowlozyk et al. 1983; Gleddie et al. 1985; Kashyap 2002), including those of hypocotyl (Kamat and Rao 1978; Matsuoka and Hinata 1979; Alicchio et al. 1982; Matsuoka 1983; Sharma and Rajam 1995a), leaf (Alicchio et al. 1982; Magioli et al. 1998; Sharma and Rajam 1995a), cotyledon (Alicchio et al. 1982; Sharma and Rajam 1995a) and root (Franklin et al. 2004). Regeneration has also been reported in cell suspensions (Fassuliotis 1975; Fassuliotis et al. 1981) and protoplast cultures (Guri et al. 1987; Sihachakr and Ducreux 1987). However, hypocotyl explants have been most commonly used for organogenesis, compared to cotyledon explants (Sharma and Rajam 1995a). Organogenic response varies considerably with genotypes and explants (Kamat and Rao 1978; Alicchio et al. 1982; Sharma 1994). In addition, the variation has also been detected within a single explant that follows a basipetal pattern. This variability in morphogenetic response correlates to changes in the spatial distribution of polyamines (Sharma and Rajam 1995a, b). This finding is supported by the results of a study showing that organogenesis in cotyledon