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Development of SCAR Marker for Detection of Sex Expression in Papaya (Carica papaya L.) from Several Genetic Backgrounds

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ABSTRACT

Papaya plants are hermaphrodite, pistillate, or staminate. Sex inheritance in papaya is determined by a single gene locus with three alleles of M which is dominant for maleness, MH for hermaphrodites and m which is recessive for femaleness. Only fruits from hermaphrodite plants are marketed since they have the necessary commercial characteristics, i.e., they are pear-shaped and have thicker flesh and a smaller internal cavity. Increased papaya yield has been limited mainly by the ratio of female to hermaphrodite (1: 2) plants normally occurring in orchards. This ratio causes great losses to papaya producers. Identification of seedlings sex during nursery stage is of prime iportance. In order to obtain simple DNA markers to identify sex expression in papaya, five SCAR markers of 20-21 primers were utilized. Examination of these markers into 24 genotypes of papaya from 12 populations of different genetic background revealed that pair of primer PKBT-5 had successfully differentiated male and hermaphrodite plants from female plants. Hence, PKBT-5 pair of primer can be utilized as DNA marker for sex expression character identification in papayas.

Key words: Papaya, sex expression, SCAR marker

INTRODUCTION

Papaya (Carica papaya L.) is a polygamous species with three sex types: male, hermaphrodite and female. In most cases, hermaphrodite plants are preferred for commercial use. Since the use of seeds produce seedlings of unknown sex expression, producers have to plant seedlings in groups of three and thin out the female and male plants after 3 to 4 months when it is possible to identify the sex of the seedlings from their floral buds (Lemos et al., 2002). Storey (1953) hypothesized that three alleles, M, H, and f, at a single locus Sex1, determine papaya sex. The alleles M and H were assumed to be dominant over the f allele. Thus, the male, hermaphrodite, and female sexes are determined by the Sex1 locus genotypes, Mf, Hf and ff, respectively. Homozygotes of dominant alleles (MM and HH) as well as a heterozygote (MH) were assumed to be lethal. Recently, Sondur et al. (1996) suggested a model of sex type based on alternate alleles of a gene encoding a trans-acting factor. They proposed that the male allele of the sex gene, designated as SEX1-M, encodes a trans-acting factor that induces male floral parts while inhibiting carpel development. The hermaphrodite allele, SEX1-H, is intermediate having the ability to induce male structures but only reducing carpel size. The female allele, sex1-f, is incapable of inducing male structures.

Burgeoning development of molecular genetics have revealed several molecular markers linked to the sex of dioecious plants. For example, AFLP (amplified fragment length polymorphism) markers were developed for asparagus (Reamon-Büttner and Jung, 2000), and RAPD markers for Pistacia vera (Hormaza et al., 1994), and asparagus (Jiang and Sink, 1997). In papaya, RAPD and microsatellite markers linked to sex have been reported (Sondur et al., 1996; Parasnis et al. 1999; Lemos et al., 2002; Urasaki et al. 2002), and their conversion to SCAR (sequence characterized amplified region (Urasaki et al., 2002; Deputy et al., 2002).

In this paper, we report an evaluation of several published SCAR markers (Urasaki et al., 2002; Deputy et al., 2002) and new developed SCAR marker from published RAPD sequence (Lemos et al., 2002; Urasaki et al., 2002)) specific to male and hermaphrodite plants into several genetic backgrounds of papaya to elucidate their consistency. Utilization of SCAR allowed rapid and reliable identification of target trait.

MATERIALS AND METHOD

Plant Materials

Plant materials consisted of 12 genetic backgrounds of papaya collections of Center for Tropical Fruit Studies (CETROFS), i.e., California (P-1), Exotica (P-2), Hawaii Solo (P-3), KD-Red (P-4), Ponti (P-5), Red King (P-6), Red King x SW Yellow (P-7), Hawaii Solo (P-8), SW Yellow (P-9), SW-Red (P-10), TW-Red

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