Three different genetic algorithms (GA) were compared to evaluate their usefulness for the optimization of transperineal ultrasound-guided prostate seed implants. The comparison among these algorithms i.e., simple GA (sGA), small-uniform-restart-elitist GA (sureGA) and small-elitist-creeping-uniform-restart GA (securGA) was made in terms of the number of function evaluations and the corresponding *fitness*. The optimized seed distribution was obtained by searching for the minimum of a *cost function* (defined as the inverse of the *fitness function*), which consists of constraints on the peripheral dose of the planned target volume, the dose uniformity within the target volume and the dose to the critical structure. The securGA provided the best performance of the three yielding near optimum results within 2500 function evaluations and using less than 5 mins on a HP735 workstation for a typical target. Our study also includes an investigation of different needle geometries using securGA. Plans were evaluated in terms of the dose nonuniformity ratio, conformation number and dose volume histograms. For fixed needle geometry, the optimized plan showed a much better dose distribution than that of a manually optimized plan and the dose to the critical structure could be reduced significantly. Optimization of irregular and skewed needle geometry yielded results, which were nearly as good as with the ideal needle geometry. We concluded that this new genetic algorithm (securGA) allows for an efficient and rapid optimization of dose distribution and is suitable for real time treatment planning optimization for ultrasound-guided prostate implant.