Suitable growing space of *Quercus mongolica* in natural mixed forests of Changbai Mountains in Jilin, China

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1. Objectives
Crown width is a good estimator of diameter growth and is closely related to stem diameter at 1.3 m above ground (DBH). The aims of this paper are to analyze the relationship between volume increment and crown width at the same DBH, and construct optimal growing space model of *Quercus mongolica* in natural forest.

2. Materials and Methods
Seven natural stands were selected in the natural mixed forests of broad-leaved and Korean pine species in Songjianghe Bureau of Forestry (127° 12'-127° 50'E, 41° 44'-42° 21'N) on the western slope of Changbai Mountains. Nine 0.06hm² plots were located randomly within each stand. DBH of all the trees within 63 plots were measured. Thirty two trees in canopy layer and 36 trees in understory were harvested destructively. The specific thinning was applying in 2007 according to the optimal growing space model. Four years after thinning, seven 1ha plots were selected randomly to verification of volume increment model in optimal growing space. DBH of all the oak in those 7 plots (total 235 oak trees) were measured in 2007 and 2011.

3. Results and Discussion
The 3-parameter sigmoid models could describe the relationship between individual volume increments to crown width of *Q. mongolica* in natural forest (Fig. 1). The power model could describe the relationship between crown width and DBH of *Q. mongolica* growing in optimal individual growing space (Fig. 2). The power model could significantly describe the relationship

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**Fig. 1** Relationship between individual volume increment and crown width of oak

**Fig. 2** Relationship between crown width under max. individual volume growth condition and DBH

**Fig. 3** Relationship between individual maximum volume increment and DBH
between individual volume increment and DBH of *Q. mongolica* growing in optimal individual growing space (Fig. 3).

The quadratic models could describe the relationship between stand volume increment and crown width of *Q. mongolica* in natural forests (Fig. 4). The power model could describe the relationship between crown width and DBH of *Q. mongolica* growing in optimal stand growing space computed from maximum stand volume increment condition (Fig. 5). The power model could also significantly describe the relationship between individual volume increment and DBH of *Q. mongolica* growing in optimal stand growing space computed from maximum stand volume increment condition (Fig. 6).

The observed volume increment from 1997 to 2007 of suppressed trees was lower than predicted volume increment utilizing the DBH in 1997 (Fig. 7, decreased 59.6-93.8%, average 84.8% under maximum individual volume increment conditions, and 50.3-90.9%, average 80.4% under maximum stand volume increment conditions, respectively).