CHAPTER 5
GENERAL DISCUSSION AND CONCLUSION

Of the various factors that affect upland rice production, low soil moisture supply is generally the most serious one. A low supply of soil moisture to the upland rice is due to uneven or inadequate rainfall, rapid drainage because of coarse soil texture or rolling topography (De Datta *et al*., 1974). In south and southeast Asia, large areas under rainfed rice suffer regularly from some degree of moisture stress. These areas are exposed to erratic distribution and quantity of rainfall (Sudhakar *et al*., 1989). Drought occurs frequently in rainfed uplands of north Thailand and can occur during any stage of crop growth. Rice plants respond to drought by reducing production of new tillers and leaves, reducing leaf elongation, rolling existing leaves and promoting leaf death. These responses reduce interception of photosynthetically-active radiation. Stomata are particularly sensitive to drought, leaf stomata conductance decreases sharply with decrease in leaf water potential, thus, reduces the rate of photosynthesis and radiation-use efficiency. These responses reduce dry matter production and eventually grain yield (Boonjung and Fukai, 1996).

There are several mechanisms by which plants can adapt to drought. The three common adaptation mechanisms or drought resistance in crops are drought escape, dehydration avoidance and dehydration tolerance (Kobata, 1995). Each mechanism may be the result of a number of traits (Fukai and Cooper, 1995). Si uptake and accumulation in rice plant was considered to be a trait, which was associated with drought resistance. From the study of the role of Si on upland rice under drought condition at tillering stage in Chapter 3, the results indicated that Si content in rice tissues could alleviate water stress by decreasing transpiration from cuticle to maintain the high leaf water potential. Since Si content in shoot tissues showed negative correlation with stomatal resistance, and positive with relative water content in rice plant, transpiration of leaves was mediated through the stomata and cuticle (Ma *et al*., 2001). These results were supported by Ma (2004) and Ma *et al*.

(2004) who reported that Si was taken up by the rice roots in the form of silicic acid and accumulated in the shoot. Si was deposited on the cell wall of epidermal cells of leaves, stems and hulls, forming a silica-cuticle double layer and a silica-cellulose double layer. Si was also deposited on the bulliform cells, dumbbell cells and long and short cells on the surface of leaves and hulls. Si played an important role in enhancing the resistance of rice to drought stress and various stresses. Hence, uptaking and accumulating ability of Si in shoot tissues could be possible and helpful as a selection criterion for breeding and improvement of drought resistance in upland rice.

In addition, the Si content in shoot tissues showed positive correlation with total dry weight, while total dry weight showed negative correlation with stomatal resistance. Therefore, the Si content in shoot tissues could maintain the photosynthetic activity for increasing in dry weight under drought condition. As stomata act as regulators for CO_2 exchange, as well perform as regulators of water loss, so water deficit is sufficient to close stomata and must also decrease photosynthetic activity (Begg and Turner, 1976). However, Si content in shoot tissues must depend on the amount of Si application in culture solution and the uptake ability of genotypes, since positive correlation was identified with Si application and significant variations were observed among the varieties for Si content in shoot tissues. These results agreed with Ma and Takahashi (2002).

Although uptaking and accumulating ability of Si in shoot tissues could be possible and helpful as a selection criterion for breeding and improvement of drought resistance in upland rice, success in plant improvement depends on the magnitude of genetic variation of traits (Poehlman and Sleper, 1994). Since genetic variability is the raw material of plant breeding and its existence and nature must firstly be established before exploitation of trait (Deren, 2001), so significant variations for Si uptake and accumulation among genotypes were important to be identified. The results in Chapter 2 indicated that variations of Si contents in rice plant tissues notably existed among the upland rice genotypes, and Si uptake and accumulation in leaf blade and stem of upland rice at tillering stage could alleviate drought stress. These results agreed with Deren (2001) and Ma and Takahashi (2002). However, it was found that Si content in leaf blade and stem of upland rice at tillering stage showed negative correlation with leaf rolling score, and Si content in leaf blade and stem varied greatly and significantly as observed among the upland rice genotypes. So, both high and low Si uptake ability were selected for further genetical study of Si content in rice plant parts.

For general conclusion, it is important to point out that the understanding of the mode of inheritance of Si uptake can be used to make important decisions about the strategies and tactics of upland rice breeding (Kearsey and Pooni, 1996). Results in Chapter 4, under drought-stress condition at tillering stage, both Hao x IRAT191 and SMGC90002-4 x SMG9037-2-1-1-2 crosses gave significant genetic variation in Si content of rice tissues. The Si content in rice tissues was controlled by a large number of genes with small effects. The phenotypic variation of Si content in rice tissues was attributed to D and E_W while Majumder *et al*. (1985) reported that the genetics of Si uptake was controlled by additive and non-additive genes.

In addition, the results showed that the average h^2_n for Si content in rice tissues in both crosses were 0.56, 0.60, 0.68, 0.56 and 0.66 for the young leaf blade, mature leaf blade, stem, root and hull, respectively. Results of this study suggested that the ability of Si uptake and accumulation in rice tissues could be employed and helpful as a selection criterion for breeding and improvement of drought tolerance in upland rice crops if crossing is made between bi-parental high Si uptake ability and followed by using more efficient selection methods.