CHAPTER 2

LITERATURE REVIEW

2.1 Rice production practices in relationship to yield and milling quality

Agricultural practices are one of management factors, which affect to yield and milling quality of rice. For example, nitrogen application, water management, harvesting date, etc. are the field management, which influence the grain yield and milling quality (Opastrakul, 1996).

Water management is one of the most important factors in rice production. It affects the physical character of rice plant. Many researches generally showed that maximum yield potential exits when the soil is maintained under flooded or saturated condition. At reproductive growth stage a large amount of water is consumed, drought at this stage causes severe damage, particularly when it occurs from panicle initiation to flowering stages (De Datta *et al.,* 1970). From this reason, it causes to loss in yield of rice. Moreover, Reddy and Hussaini (1984) supported that both grain yield and milling quality are influenced in the water management.

Rice plant required nitrogen as much nitrogen as possible at the early and mid tillering stage to maximum of panicle and the plants still required nitrogen, even in the ripening stage (Matsushima, 1964). The functions of nitrogen in rice are particularly important to increases grain yield and increase the protein content in rice grain. Nangju and De Datta (1970) showed that increasing nitrogen fertilizer up to 120 kg/ha could increased head rice yield. Moreover, increment nitrogen fertilizer would increase the physical characteristics of grain rice in terms of thickness (Attaviriyasak *et al.*, 1975), while Wongsuthachin (1973) reported that nitrogen fertilizer effect on physical properties by reducing percentage of starch granule. This mean that the increment of nitrogen can reduce the cracking of the grain, therefore, percentage of broken rice will be decreased and improved percent of whole grain.

According to timely harvesting, it obviously impacts to yield and milling quality of rice. As the farmers lately harvest their product, it results in grain losses due to shattering, lodging, rats, birds, insects and other pests. Govindaswami and Ghosh (1968) from India reported that harvesting between 27 and 39 days after flowering (at moisture content 18-23%) gave maximum head rice recovery. Harvesting before or after that period resulted in an increase of broken grains. In Japan the best time to harvest was 20-35 days after heading (Eikichi, 1954). In California, some growers reported high head rice yield by harvesting at 22-26% moisture content. In Arkansas, rice is harvested at 18-22% moisture content (Huey, 1977). At that stage, the head has turned downward and the grains in the lower parts of the head are in the hard-dough stage. Rice harvested before that stage might have a high percentage of light, chalky kernels, which reduce yields of head rice and total milled rice. If harvested later, there may be considerable loss from shattering. The optimum time to harvest is varies among location and countries depended on the other factors in those locations. Huysmans (1965) summarized that late in harvesting can result in a considerable loss in value of their crop.

In terms of genetic or rice varieties, Khush (1979) reported that head rice recovery is dependent upon grain size, shape and appearance of rice grain. In general, varieties and breeding line with long or long bold grain and those having chalky grains give lower head rice yields. Varieties having medium long, slender and translucent grains give the best head rice yields.

2.2 Rice quality

Rice quality may be classified into four categories and interrelated areas: 1) milling quality; 2) cooking, eating quality; 3) nutritive quality; 4) specific standards for cleanliness and purity (Webb *et al.*, 1975). It was reported that the quality of rice demanded by one community might be completely unacceptable to another. For example, in Japan, they prefers a well-milled, short grain japonica rice; the Thailand consumers prefer long grain rice; a long grain rice with strong aroma is preferred in the Middle East; compare to the European consumer which prefers a long grain rice with no scent (Efferson, 1979).

Rice milling quality is a major determinant of paddy prices in the world markets. Milling quality is determined by the quantity of total milled rice and the percent head rice that can be produced from a unit of rough rice (Jongkaewwattana, 1990). Head rice is grain that remains whole completely or by at least ¾ of the whole grain after the milling process. High quality milled rice has low percentage of broken kernel and high percentage of head rice. The head rice yields vary widely, depending on the variety, grain type and cultural practices. Consequently to obtain the maximum milling yield must be considered right from the sowing to the milling process (Irshad, 2001).

2.3 Foliar application of micronutrients

Microntrients are usually required in small amounts and can be applied through leaf as you can cover the plant's need with two or three annual applications. The foliar application method is usually preferred because very small amounts are applied per area and nutrients can be absorbed through plant leaves. In some situations, foliar-applied micronutrients are more readily available to the plant than soil-applied micronutrients, but foliar applications do not provide continuous nutrition as do soil applications.One of the reasons for foliar application of micronutrients is that in soil with pH over 7.5 most micronutrient becomes unavailable and therefore practically useless (Lancaster, 2000).

When spray equipment is available, secondary and micronutrient needs of plants may be met with a good spray program. Foliar applications must use low rates for young plants and high rates when plants develop dense foliage. Micronutrient chelates are generally no more effective than water-soluble inorganic sources when foliar applied. Chelates, however, are more compatible when mixed with other spray materials (Vitosh *et al.*, 1994).

The effectiveness of foliar applied nutrients is determined by (1) The condition of the leaf surface, in particular the waxy cuticle. The cuticle is only partially permeable to water and dissolved nutrients and it can limit nutrient uptake. (2) The length of time the nutrient remains dissolved in the solution on the leaf surface. (3) Diffusion, the movement of elements must diffuse from a high concentration to low concentration. When diffusion occur, the nutrient must dissolve. (4) The type of formulation, water-soluble formulations generally work better for foliar application, as they are more easily absorbed when compared to insoluble solution (http://www.ecochem.com/t_foliar.html).

2.4 Effect of potassium iodide on grain quality of rice

Pruenglampoo *et al.*, (2000) explored the possibility of enhancing grain iodine content by applying potassium iodide in the rice field and to study the effect of potassium iodide on grain yields, and the levels of some mineral in rice grain. As the result, applying potassium iodide both directly into soil and spraying on plants produced significantly increases in percentage of head rice and reduction the percent of unfilled grain as compared with the control plants.

To support this study, Chankruayat (2000), studied the effect of nitrogen fertilizer application rates and timing of foliar application of potassium iodide on yield, milling quality and iodine content in rice grain. The experimental result showed that an increasing in nitrogen application level had positive impact on growth and yield, however, nitrogen application showed no effect on percentage of head rice and iodine content in brown rice of all varieties. Beside application times of potassium iodide had no effect on growth and yield of rice for all varieties, but had significant positive effect by increasing head rice yield particularly when applying weekly starting from PI (panicle initiation) till anthesis.

2.5 Roles of potassium in plant

Potassium (K) is required by all plant and animal life. Plants require potassium for photosynthesis, osmotic regulation and the activation of enzyme systems. Potassium activates many enzyme systems and in particular is generally considered to improve the energy status of plants and the metabolism of carbohydrates, as well as improving tolerance to stress. A satisfactory level of potassium nutrition has a wide range of effects on crop quality and behavior:

- it increases carbohydrate content (sugar, starch, fiber) and thus improve quality of crops such as sugarcane, potatoes and jute;
- it increases the content of a number of vitamins, important in fruit and vegetable crops for fresh consumption;
- correct potassium nutrition prevents certain forms of blackening in potato tubers;
- in cereals, the grain filling period is extended and grain size is increased by an adequate potassium supply, and the degree of lodging can be reduced; resistance to frost, drought, diseases and pests are all improved by a satisfactory potassium supply.

2.6 Effects of potassium absorbed at different growth stage

In water culture experiments, Ogihara and Tanigawa (1950) showed the effects of K absorbed at various stages of growth on yield of rice. They will be follows as: (a) K was absorbed at about the maximum tillering stage, it will increases the number of panicles and grains, (b) K was absorbed at the ear formation stage, it will increases panicle and grain numbers as well as the thousand grain weight, (c) K was absorbed after panicle formation mainly, it will improves the weight of the grain.

Potassium absorbed during the period 35 to 45 days before heading (the time of maximum tillering stage) was the most effective in increasing the grain yield. (Kiuchi *et al.*, 1951 and Ogihara *et al.*, 1950). Although K is more effective at the tillering and ear formation stages, water culture experiments have shown that the grain yield is still increased when the K supply is continue through the heading stage.

Park (1974) showed that rice yields were most sensitive to K depletion during the 2 to 3 week period prior to heading, when the yield was 26% to 45% lower than the control, in which K was supplied in the nutrient solution at a concentration of 40 ppm throughout the growth period.

2.7 Roles of iodine for human

Most of iodine in nature resides in the ocean. Iodine was leached from the surface soil by glaciers, snow and rain and was carried by wind, rivers and floods into the sea. Iodine occurs in the deeper layers of the soil and is found in oil-well and natural gas effluents. Water from such deep wells can be a major source of iodine in the diet. Iodine ions are oxidized by sunlight into elemental iodine in the atmosphere and returned to the soil by rain. However, the natural return of iodine to the soil is slow and small in amount compared is to the original loss of iodine. Crops grown in iodine-deficient soil are also iodine deficient. Because humans are dependent on crops for iodine, they can also become iodine deficient if they eat vegetables grown in iodine-deficient soil (http://www.madsci.org/posts/archives/feb99/919816280.Me.r.html).

Iodine is an essential trace element for humans. The average adult body contains between 20 and 50-mg iodine, and more than 60 percent of this is concentrated in the thyroid gland situated at the base of the neck. The rest is in thyroid hormones in the blood, ovaries and muscles. Worldwide soil distribution of iodine is extremely variable and food grown in areas of low iodine does not contain enough of the mineral to meet requirements (Delange and Lecomte, 2000).

In addition, iodine is a component of the thyroid hormones triiodothyronine and thyroxin, which determine the metabolic rate of the body. This effects the body's conversion of food into energy and also the way energy is used. Thyroid hormones are vital for growth and development of all organs, especially the brain, reproductive organs, nerves, bones, skin, hair, nails and teeth. When body iodine stores are exhausted, it leads to various illnesses, which are known as iodine deficiency disorders and includes hypothyroidism, goiter and cretinism. Intakes of less than 50 mcg per day will induce deficiency (Smyth, 1993; Ghent and Eskin, 1993).