CHAPTER 5

DISCUSSION

5.1. Vegetable Soybean Yield and Dry Matter Accumulation

Vegetable soybean responded to the N fertilizer applications in marketable pod yield, total pod yield and also biomass accumulation. Similar results were also reported by Liang (AVRDC, 1990), Maneechote (AVRDC, 1991) and Huter *et al* (1991), who claimed that starter N was not sufficient for maximizing vegetable soybean pod yield.

The timing of N application played a key role in producing the maximum yield. At the early stage (from germination to two weeks after it), vegetable soybean plants needed sufficient N for the vegetative growth. Neunylov and Slabko (1967) reported that N supplied prior to bloom resulted in better growth, larger leaf area, more abundant flowering and higher yield. It is probably explain why adding top dressing at the flowering (F2) got low marketable and total yield compared the top dressing at the V1.5 stage since it gave lower vegetative dry matter accumulation at the flowering stage (Table 1 and Table 2). This agreeed with the result of DeMooy *et al* (1973), which showed that a large accumulation of N during the period from initiation of flower buds to the beginning of flowering is important to maximize the leaf area and to retain as many flowers on the plant as possible for increased seed production. Sinclair and Dewit (1976) found that it was the loss of N from vegetation in support of pod development that was responsible for "self-destruction". Wittenbach *et al* (1980) showed that the loss of N from soybean leaves of field-grown plants was concurrent with changes in chloroplast structure and loss of photosynthetic activity during grain filling.

Many reports have shown that during the reproductive stage, vegetable soybean needs supplemental N application. DeMooy *et al* (1973) found that the period of flowering is frequently named by those contending that the soybean crop needs more N than soil and symbiosis commonly provided. In AVRDC, Taiwan, China, through 6 years' research Huter *et al* concluded that 30 kg N/ha (50%) should be applied as basal, 18 kg N/ha (30%) at 15 DAS and 12 kg N/ha (20%) at PIS. Maneechote (AVRDC, 1991) also reported that three time N fertilizer applications (basal, 10 DAE, 20 DAE, 48 kg N/ha for first two time and 41.6 kg N/ha for the third time) is not sufficient for obtaining maximum yield, one more time nitrogen application after flowering (45 DAE, 73.6 kg N/ha) increased marketable yield and total yield 22.4% and 20.5% respectively.

The effects of N fertilizer treatments in this study showed that the cause of increasing marketable pod yield of vegetable soybeans was through the increase of the marketable pod number per plant. Watanabe *et al* (1986) concluded that soybean′ N demand during ripening stage, and its low response to basal fertilizer, might best be resolved by applying supplemental N after flowering. It is therefore important in the management of vegetable soybean to make sure that the N requirements for seed development is adequate. DeMooy and Sutherland (1979) found that the transfer of nutrient from the leaves to the developing seed is closely related to leaf senescence and dehiscence, which in turn related to nutrient uptake by the leaves. The obvious interest they found in preventing leaf senescence during pod-fill is to continue the absorption of active nutrients and the process of N-fixation, as well as to promote the transfer of more nutrients to the seed-all of which would increase the productive capacity of the crop. Since the nitrogen fertilizer treatments had no effects on the total pod number, at the seed development stage, If the plant can uptake enough nutrient, the pod initiated two seed will be developed successfully and come to the marketable pod; while if the plant do not get sufficient N nutrient, the seed development may fail and become potential nonmarketable pod. From the table 5, it showed clearly that minimum starter N application (F1) got minimum marketable pod number per plant while it obtained maximum potential nonmarketable pod number per plant. In contrast to the minimum starter N application, adding top dressing at the early V1.5 stage, and the second dressing either at the flowering or the late pod formation stage, both increased more the marketable pod number and less potential nonmarketable pod number, therefore increased significantly the marketable yield.

5.2. Nitrogen Fixation

5.2.1. Nodulation and P(fix)

The result showed that there was a positive relationship between P(fix) and available N content in the soil at the stage V4, but this relationships became negative at the R1 and R3 stage and disappeared afterwards (Figure 6). During V4 stage, adding 50 kg N/ha as the first top dressing at the V1.5 stage increased the nitrogen supply, and therefore enhanced the plant growth as well as nodule growth and finally increased P(fix) at the V4 stage (Figure 4, Figure 7 and Table 8). From R1 to R3, the higher level of nitrogen supply depressed the nodule growth and therefore decreased the P(fix). This why the treatment F1 with starter N of 25 kg /ha obtained the maximum nodulation and P(fix) from R1 to the final stage since the N supply in this treatment was the minimum (Figure 4, Figure 7 and Table 8). After R5 stage, since there was no significant difference on the available N content in the soil among the different treatments and thus, the depressing effect on nodulation bocome weaker and disappeared after R5.5 stage. This kind of result was interpreted by Marscher (1986), who explained that during the first few weeks of symbiotic development, combined N is essential for plant growth, which in turn can enhance nodule growth. Therefore, in soil with very low levels of combined N, N deficiency can depress plant growth and subsequently limit photosynthesis which in turn may limit nodule growth and N fixation. Thus, from low level of combine nitrogen, N fixing legumes can response to increasing levels of mineral N to an optimum level, after which nitrogen fixation will be inhibited with further increase in combined N. This is why at the stage V4, adding 50 kg N/ha as top dressing at earlier V4 stage increased both plant and nodule growth and subsequently increased the P(fix). After V4 stage, the nodules grow strong enough to fix certain amount of nitrogen, over N supply would depressed the nodule growth and subsequently reduce the P(fix). This may explain why the treatment F4, adding the first top dressing at 50 kg N/ha at the V1.5 stage and the second dressing at 25 kg N/ha, depressed most among the six N fertilizer treatments on the nodule growth and therefore reduced the P(fix) at the R1 and R3 stage. Similar research done by Ying *et al* (1992) at the same station of Chiang Mai University also showed that nodulation was inhibited by nitrogen fertilizer applications to either rice or soybean starting at the V6 stage and disappeared after R5 stage.

5.2.2. Total Amount of N Fixed

Lower shoot dry matter and total nitrogen uptake were related to low levels of nitrogen fertilization. In this experiment, minimum starter N application (F1) resulted in lower shoot dry matter accumulation and nitrogen uptake (Table 3 and Table 7). This might indicat that in soils with low combined nitrogen, vegetable soybean at the early stage could not absorb enough nitrogen from the soil, which caused a nitrogen stress to plant growth. This early stress depressed plant growth and subsequently limited nitrogen fixation in treatments with low levels of combined nitrogen (Figure 1). In this experiment, with starter N at the 25 kg N/ha, the plant fixed 117 kg N/ha in 301 and 124 kg N/ha in AGS292, however, adding one time top dressing of 50 kg N/ha at the V1.5 stage or further adding the second dressing of 25 kg N/ha at the R4.5 stage, the plants could fix N up to 140 kg N/ha. This result was consistent with the common observation by Streeter (1987). He found that early nitrogen deficiency can depress growth and photosynthesis, which may subsequently limit nitrogen fixation, and that fixed nitrogen alone is not sufficient for maximum nitrogen apply in vegetable soybean. The similar result done in same station was reported by Ying *et al* (1992), who found that N fixation in soybean was increased by the use of nitrogen fertilizer with either the residual effect from rice or higher levle of starter N application on soybean. Without N to either crop , soybean fixed 122 kg N/ha. Supply of starter N at 50 N/ha, or the residual effect of 300 kg N/ha to rice increased the amount of N fixed to 140 kg N/ha. Hansen *et al* (1989) also found that soybean relying entirely on symbiotic nitrogen only had half nitrogen uptake of those given some combined nitrogen. This is why the minimum starter N application (F1), which had the highest the proportion of plant nitrogen derived from N fixation, the total amount of nitrogen fixed still was not more than that of the higher levels of nitrogen application except the case of the Farmer´ practice (F4). Furthermore, this also may explain that delay second dressing at the late pod formation stage (F6) enhanced the total amount of nitrogen fixed through the highest the total nitrogen uptake (Table 7). This is agreed with Watanabe *et al* (1983), who found soybean had a relatively high N requirement, especially in the later growth stages.

However, adding top dressing at the early V1.5 stage and the second dressing at the V4 stage (Farmer´s practice), strongly depressed the total amount of nitrogen fixed through inhibiting nodule formation and the proportion of plant nitrogen fixed (Figure 4 and Figure 7). Watanabe *et al* (1983) found that excessive basal N promoted soybean vegetative growth (Table 2), which could lead to lodging or a reduction in the development of nitrogen-fixing nodules. Similar result was also reported by Hansen *et al* (1989), who found that symbiotic performance of soybean grown at different nitrogen regimes stated that high nitrogen level caused low nitrogen fixation. Ying *et al* (1992) also found that starter N at the rate either 25 kg N/ha or 50 kg N/ha had no depressing effect on N fixation when 100 kg N/ha was supplied to rice, but starter N at the 50 kg N/ha significantly decreased N fixation following the application of 300 kg N/ha to rice.