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Effect of Juvenile Leaf Removal on Symbiotic N Fixation and Yield of Mungbean (*Vigna radiata* (L.) Wilczek)

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ABSTRACT

A randomised complete block design with 3 replications was conducted on Bangkhen soil series at Kasetsart University, Bangkhen campus in the early rainy season of 1994. The treatments composed of O, 33, 66 and 100% juvenile leaf removal of mungbean at the V 4 stage. The results indicated that the higher the degree of leaf removal, the lesser the nodule number, nodule dry weight, symbiotic N fixation, total dry weight and seed yield were expected. Number of pods per plant was the only yield component that had a main effect on yield. The loss on 33% juvenile leaves was not as severe as those of the 66 and 100% in terms of seed yield when compared to the control.

Key words : juvenile leaf, total N fixation, total dry weight, yield components, seed yield.

INTRODUCTION

Leaves are the energy generating house of plants where photosynthate is produced and then translocated to different parts for growth and development. Most often, leaves are partly or totally lost by insect, disease, rodent and storm damages, thus reducing their ability to produce photosynthate essential for different plant activities. The effect on plants depends on how severe leaves are damaged and when the loss occurs. In some cases, whole crop is lost and no yield is produced.

Prompheat (1992) studied on young leaf removal (YLR) at 50 % first flowers bloom of three different mungbean varieties in two seasons. This author found that the removal of two terminal leaflets (2/3) of the trifolioate leaves produced 1.3 tonnes of grain yield per hectare in the dry season. However, when only a terminal leaflet (1/3) was removed the yield was only 943 kg per hectare in the early rainy season. The data suggest an existence of the competition among young leaves for assimilates. Raksong (1993) worked on mungbean at R_1, R_2 and R_3 stages and YLR of 1, 2 and 3 leaflets per one trifoliolate leaf. She found that YLR at R_1, R_2 and R_3 in both dry and early rainy seasons did not affect grain yield, yield components and harvest index. The tendency was that the

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greater the number of young leaves removed the lower the grain yield.

The work on defoliation of mungbean is considerably limited in comparison with that of soybean. Boonyanupong (1994) studied young leaf removal at three different reproductive stages, R_1, R_3 and R_5 (Fehr and Caviness, 1977) of soybean and found that YLR at R3 tended to produce higher 100 seed weight, pod number per plant and grain yield in both dry and late rainy seasons. The work of Chanprasert *et al.* (1989) gave a clear picture of competition between vegetative and reproductive growth. They found that YLR at R1, R3 and R5 stages diverted assimilates to cause an increase in flowers or pods for at least a short period during development in both Amosy and Matara cultivars. Matara has a less plastic growth reponse than Amsoy and did not respond well to treatments. In Amsoy, although 50% YLR did not change the proportion of combined reproductive abortion, it tended to increase pod set and seed yield.

Fehr *et al.* (1977) studied the response of the indeterminate and determinate soybean cultivars to 100 % defoliation and 100% half-plant cut off at six reproductive stages form R2 to R7. They found that the determinate cultivars had a significant yield reduction from 100% defoliation than did the indeterminate cultivars at all reproductive stages, except the R7. Averge yield reduction from defoliation for all stages was 59% for the determinate cultivars, compared with 39% for the indeterminate cultivars. Maximum yield loss from the 100% defoliation occurred at R4 and R5 for the determinate cultivars and at R5 for the indeterminate cultivars. Average yield loss from half-plant cut off was similar for both indeterminate and determinate cultivars, but there was a significant interaction with stages. Similar work was conducted by Tiegen and Vorst (1975) on soybean response to stand reduction and defoliation. Treatments consisted of 0, 25 and 50 % levels of stand reduction and defoliation in all combinations at both growth stages, V7 and R3. They found that stand reduction alone reduced seed yield a maximum of 17% while defoliation alone reduced seed yield a maximum of 6% . The largest yield reduction occurred when the 50% stand reduction and 50% defoliation was imposed during the reproductive stage. More pods and heavier seeds were produced on plants remaining after stands were reduced. Defoliation during the reproductive stage reduced seed yield, number of pods per plant, and lodging more than similar treatments applied at the vegetative stage. Number of seeds per pod was not singnificantly influenced by the treatments. They concluded that low levels of defoliation removed leaf tissue which contributed little to seed production and the soybean conmunity was able to compensate for plants removed from the population. Most of the compensation was due to an increase in number of pods per plant.

The objective of this experiment was to study the effect of different degrees of juvenile leaf removal at vegetative growth on symbiotic N fixation, other attributes and yield of mungbean.

MATERIALS AND METHODS

A randomized complete block design with three replications was employed to study the effct of juvenile leaf removal of mungbean. The experiment was conducted in the open greenhouse of Department of Agronomy, Kasetsart University, Bangkhen campus. Soil type is classified as Bangkhen soil series. Plot size of each treatment was 3 x 3 square metres. After seedbed was prepared, ammonium sulphate at the rate of 15 kg per hectare was uniformly distributed, it was then thoroughly mixed into the soil. Seeds of Kamphaeng Saen 2 variety were inoculated with mixed-strains rhizobium inoculum for mungbean before sowing. Seeds were sown on 2 May 1994. The distance between rows was 50 cm and between plants in a row was 10 cm, giving a target population of 200,000 plants per hectare.

The treatments imposed were as follows : no juvenile leaf removal (0.%), 33% juvenile leaf removal, 66% juvenile leaf removal and 100% juvenile leaf removal. Juvenile leaf removal started at V4 growth stage as classified by Pookpakdi *et al.* (1992). V4 is classified as the fourth node stage where the 3rd trifoliolate leaf attached to the fourth node is fully expanding and flat while the 4th trifoliolate on the upper node starts unroll. Leaf removal started from the 3rd trifoliolate leaf upward leaving two unifoliolate leaves and two trifoliolate leaves at the bottom was undisturbed. Zero percent (0%) is no Juvenile leaf removal. Thirty three percent (33%) is the removal of one terminal leaflet of each trifoliolate leaf. Sixty six percent (66%) is the removal of the lateral leaflets. One hundred percent (100%) is the removal of three leaflets. The leaflet removal was done by a pair of scissors at the base of each leaflet when it started to expand and flat and the leaf removal was done upward until no trifoliolate leaf was produced. Juvenile leaf is classified as the leaf that starts to unroll and flat in nature.

Subsampling was done for five times with seven days intervals starting at 29 days after sowing. In each sampling, five plants were randomly taken from each treatment. They were dug carefully to prevent the loss of nodules. Root was cut at the cotyledonary node and all roots were put in a jar filled with acetylene gas to measure symbiotic N fixation activity as described by Hardy *et al.* (1968). Reduced gas was collected in vacuum tube and then it was injected into gas chromatograph, Hewlett 5890, Packard Series II to measure ethylene peak area. Each peak area was computed and expressed as total N fixation activity (U mole $plant^{-1} hour^{-1}$). The roots were removed from the jar and nodules were picked and counted. Then they were dried in oven at 80°C for at least 48 hours and finally weighed and recorded in grammes. The roots and the tops were also dried the same way, then they were recorded as a total dry weight.

Mature pods were harvested when they started to turn black. The first pick was at 80 days (22 July 1994) after sowing successive picks were done until no pods left on the plants. Pods were dried in the sun for three days, then they were threshed and recorded as final yield. Yield was based on five square metres but yield components were determined from five random plants. The yield components were number of pods per plant, seeds per pod and one thousand seed weight.

RESULTS AND DISCUSSION

Nodule number, nodule dry weight, total N fixation activity and total dry weight

Effects of juvenile leaf removal on nodule number, nodule dry weight, total N fixation activity and total dry weight were of similar pattern. Successive increases in the degrees of leaf removal caused successive decreases in nodule number, nodule dry weight, N fixation activity and total dry weight. In other words, the greater the leaf removal, the lesser the output was expected. Figure 1 illustrate that when no juvenile leaf removal (0%) was imposed in the experiment, total numbers of nodules were high in all five samplings. When juvenile leaf removal was increased to 33, 66 and 100%, respectively, the total numbers of nodules decreased correspondingly to the degrees of leaf removal. Nodule dry weight (Figure 2), N fixation activity (Figure 3) and total dry weight (Figure 4) followed the same pattern of that of the nodule number. Nodule number, nodule dry weight, total N fixation activity and total dry weight showed a close relationship among one another (Table 1). Correlation coefficients (r) among these characteristics were all highly significant ($P < 0.01$) except total N

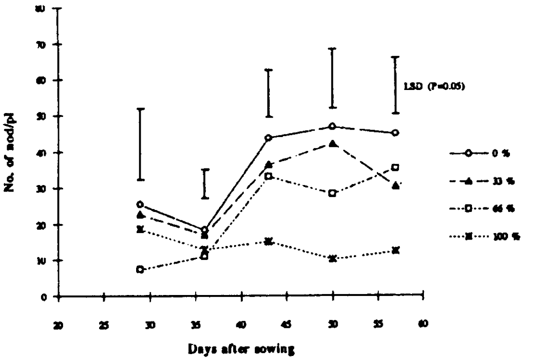

Figure 1 Effect of juvenile leaf removal on nodule number per plant.

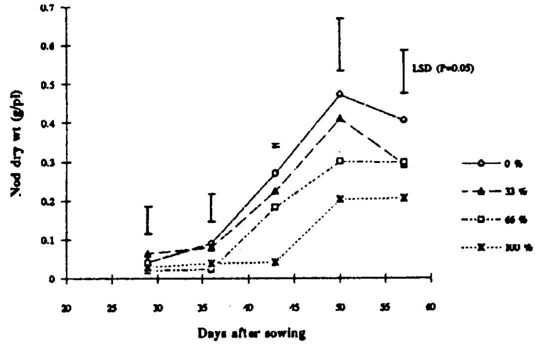

Figure 2 Effect of juvenile leaf removal on nudule dry weight per plant (g).

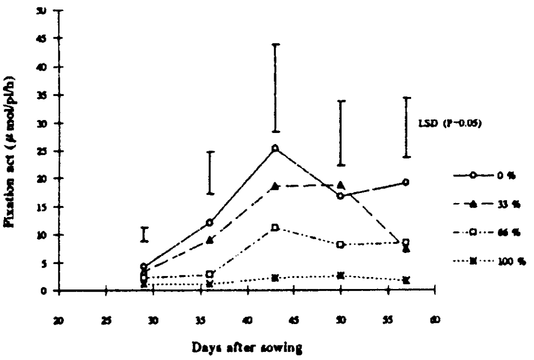

Figure 3 Effect of juvenile leaf removal on total N fixation activity (μmol/pl/h).

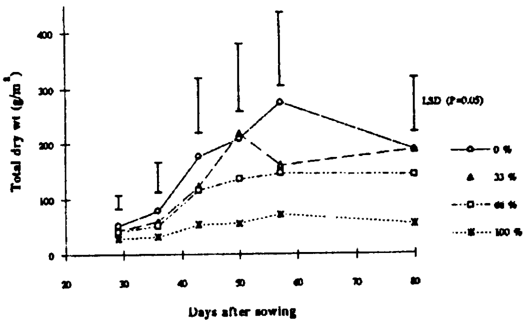

Figure 4 Effect of juvenile leaf removal on total dry weight (g/m^2).

Table 1 Correlation coefficient (r) between nodule number, nodule dry weight, total N fixation activity, total dry weight and seed yield of different leaf removal.

	Nod No.	Nod dry wt	Total N fix. act.	Total dry wt	Seed yield
Nod No.		0.81**	0.76**	0.73**	0.67**
Nod dry wt		-	0.64**	0.83**	0.83**
Total N fix. act.			-	0.70**	0.41*
Total dry wt				-	0.72**
Seed yield					

* Significant at P=0.05

** Significant at P=0.01

fixation activity and seed yield were significant ($P < 0.05$). It indicated that symbiotic N fixation was closely reated to nodule number, nodule dry weight total dry weight, and seed yield, respecively. This finding is partly in agreement with that of Inthong (1987) when he worked on the effect of inoculation, amount of nitrogen fertilizer at sowing and flowering on nitrogen fixation and yield of mungbean.

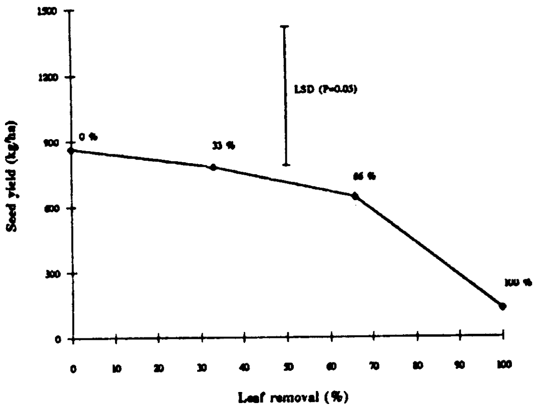

Figure 5 Effect of juvenile leaf removal on seed yield (kg/ha).

Yield and yield components

Among the different characteristics of yield components studied, number of pods per plant was the only yield component that contributed to the seed yield (Table 2). Number of seeds per pod and thousand seed weight did not show any effect on yield in this experiment. The results suggest that if one wants to increase yield of mungbean, special attention must be put on the number of pods per plant rather than other yield components. Although the yield decreases from 0% to 33, 66 and 100% juvenile leaf removal were not statistically significant, the drastic decrease of about 900 kg per hectare (0% leaf removal) to about 130 kg per hectare (100% leaf removal) was really great in terms of investment (Table1 and Figure 5). If this situation was superimposed into the natural cocurrence, the losses of 33 and 66% leaves whether by diseases or insects would affect yield considerably. A loss of 100% of leaves would be a great failure to the grain yield. This indicated that leaf removal was the major cause of yield decrease. When leaf number was decreased, nodule number,

Table 2 Effect of juvenile leaf removal on seed yield and yield components.

Leaf removal	No. of pods/pl	No. of seeds/pod	1,000 seed wt g)	Seed yield (kg/ha)
0%	15.33	10.25	62.82	862.60
33%	12.13	10.74	62.91	778.90
66%	9.80	10.04	60.25	640.00
100%	3.60	8.31	69.10	129.50
Significance	*	ns	ns	ns
LSD0.05	7.64	-	-	-
LSD0.01	11.57	-	-	-
CV(%)	37.41	24.25	11.31	52.26

* Signifcant at P=0.05

nodule dry weight, N fixation activity, total dry weight and seed yield were also decreased as the chain effect.

Seed yield was closely correlated to nodule number, nodule dry weight, total N fixation activity and total dry weight (Table 1). Therefore, in obtaining high yield in mungbean those characteristics must be strongly put into consideration.

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