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THE PERFORMANCE OF SOYBEAN (c.v. Americana) ESTABLISHED BY ZERO TILLAGE TECHNIQUE IN IMPERATA FIELD CONTROLLED BY HERBICIDES

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ABSTRACT

A field experiment was conducted to investigate the performance of soybean (c.v. Americana) when established with zero tillage technique on *Imperata dominated* area. Four different techniques of alang-alang control i.e. imazapyr (20 kg ai/ha), glyphosate (25 kg ai/ha), glufosinate (3.0 kg ai/ha) and manual cultivation were arranged factorially with time of plantings i.e. 1,2 and 3 months after treatments.

The alang-alang damages varied with herbicides and times, imazapyr (20 kg ai/ha) showed slow appearance of damage at 3 months after application it was only 69%, while that of glufosinate was already down to 48% due to regrowth.

No phytotoxicity was recorded, but the yield was low.

INTRODUCTION

Soybean, *Glycine max* L. Merrill, is promising and a proven source of plant protein and edible oil, containing 39-45% (dry matter basis) high quality protein with excellent amino acid pattern and 20-23% (dry matter basis) edible oil with considerable unsaturated fatty acids (Hittle 1974).

In Indonesia, the soybean production in 1973 was 541 000 tons with the domestic consumption of 505 000 tons. Indonesia was exporting 36 000 tons, however, since 1975 Indonesia has been importing an increasing amount of soybean reaching more than 500 000 tons in 1983, spending a considerable amount of precious devisa. Actually, the Indonesian production of soybean had been from 492 000 tons annually during Pelita I (First Five Year Development Plan), to 568 000 tons annually during Pelita II (Second Five Year Development Plan) and 622 000 tons during Pelita III (Third Five Year Development Plan); however, this production could still not meet the domestic demand and a considerable amount of soybeans has to be imported (Sihombing 1985).

Various efforts have been tried to increase the production of soybean in Indonesia; these are through intensification as well as extension program. Areas available for further agricultural expansion are, unfortunately, those classified as marginal land (Driessen & Soepraptohardjo 1974); some of those areas are dominated by alang-alang *(Imperata cylindricd).* This type of areas has been given a high priority for agricultural development (Sastrosuwarno 1981); therefore, it is imperative to develop techniques applicable to areas dominated by this weed to utilize the area into an agricultural production system.

Manual and mechanical cultivation were reported to be successful, when done during the dry season (Sembiring and Supardjo 1981; Mangunsong 1976), but the hazard of erosion can be of considerable magnitude (Suwardjo 1986, Coaster 1936), so manual and mechanical cultivation are considered less favorable and zero tillage may be a good alternative to those techniques.

Tjitrosemito *et al.* (1983), reported that glufosinate at 3 kg ai/ha was able to control alang-alang well; and the subsequent work in pots indicated that even glufosinate 1-3 kg ai/ha was enough to control alang-alang followed by establishment of soybean (Tjitrosemito and Wiroatmodjo 1983). However, the regrowth of alang-alang under treatments of glufosinate was usually quite high after 3 months.

As pointed out by Tjitrosemito (1985) there are several factors affecting the success of this technique among others, the appropriate planting time after herbicide application. Ideally, crops should be planted immediately after spraying to take advantage of dying *Imperata* with no germination of other weeds yet; but it may have to consider the residual activity of herbicide and avoid the possible phytotoxi-city of crops by that herbicide. This work reports on the effects of different planting time after spraying from 1-3 months on the growth performance of soybean (c.v. Americana).

MATERIALS AND METHOD

The work was carried out from August 1985 to March 1986, at the BIOTROP experimental field, which had been grown with alang-alang for the last three consecutive years. The field was divided into 36 plots measuring 4 x 5 m^2 with pathways of 1 m wide in between plots. The pathway was cleared from alang-alang during the whole experimentation by slashing.

The experimental design was split-plot. The main plot consisted of four different methods of alang-alang control, i.e. foliar application of herbicides imazapyr (20 kg ai/ha), glyphosate (2.5 kg ae/ha), glufosinate (3.0 kg ai/ha) and manual cultivation, while the subplot consisted of three different time of planting, i.e. 1, 2 and 3 months after spraying/treatment and replicated 3 times.

Before planting, the standing dead alang-alang was flattened by rolling a drum over the plots. The soybean (c.v. Americana) was planted at a distance of 40 x 20 cm by dibbling three grains in each hole. Plastic strings were extended across the plot 40 cm apart and a very shallow furrow was made along the extended string to facilitate fertilizer application before dibbling.

The fertilizer was applied as basal treatment as TSP, urea and K_2SO_4 at 60 kg P_2O_5, 45 kg N, and 50 kg K_2O/ha.

To protect the soybeans from *Agromysa phaseoli,* Furadan 36 was applied and Azodrin at 2 cc/1 was sprayed weekly for 4 weeks. The spraying was repeated whenever necessary. Manual weeding was done 2 weeks after planting at all treatments by cutting weed at ground level.

The percentage of damage to alang-alang at planting time was recorded and analyzed statistically. The growth performance of soybean was evaluated in terms of plant height, leaf number, leaf area, yield and weight of 100 grains of soybean.

RESULTS AND DISCUSSION

1. Percentage of damage to alang-alang at planting time

The percentage of damage to alang-alang is presented in Table 1.

Table 1. The average percentage of damage to alang-alang at planting time.

	Time after	spraying (months)	
Method of control	1	2	3
1. Imazapyr (2.0 kg ai/ha)	18.3	30.0	69.3
2. Glyphosate (2.5 ae/ha)	30.0	86.0	88.3
3. Glufosinate (3.0 kg ai/ha)	99.3	84.3	48.3
4. Manual	81.7	60.0	31.7

LSD (CxT) : 17

The average percentage of damage reflected the character of the herbicide used. Imazapyr (2.0 kg ai/ha) produced a slow appearance of visual damage. One month after spraying, alang-alang exhibited only 18.3% damage increasing to 69.3%, two months later. Glyphosate (2.5 ae/ha) caused a faster appearance of visual damage i.e. 30.0% at one month and 88.3%, 2 months later. These two herbicides are both systemic, affecting the synthesis of amino acids (Shaner et al. 1985). Glufosinate

showed a very rapid action in terms of visual symptoms which were almost complete one month after spraying. However, the affected alang-alang recovered soon and regrowth was quite extensive 3 months after spraying. It was not different from manual control. Glufosinate is a strong inhibitor of glutamine synthesis in plants, inducing a rapid built-up of ammonia which reaches toxic level (Kochler and Lotzsch 1985).

No phytotoxicity was observed in all treatments. This was contrary to the previous work on imazapyr where at 1.5 kg ai/ha it affected the growth of soybean. This may be due to possible leaching under field condition which did not occur in pots since they were not perforated and soybean exploited soil in pots extensively (less soil in pots). It is also possible that the variety Americana is more tolerant to imazapyr than ORBA, the variety used in the previous work. Further studies in this line are needed.

Time of planting after treatment did not affect the height of soybean plant as indicated by the absence of phytotoxicity. One month after spraying was sufficient to avoid the phytotoxic effect of glyphosate, glufosinate or imazapyr in terms of vegetative growth.

Contrary to the time of planting after treatment, alangalang control affected the growth of soybean considerably. At two weeks old, soybean under manual cultivation grew shorter (10.1 cm) compared to those with herbicide treatment (Table 2). At 8 weeks, the growth of so.ybean under glufosinate (3.0 kg ai/ha) slowed down, but it did not differ from those under manual cultivation, while those under glyphosate (2.5 kg ai/ha) grew tallest (53.4 cm).

Table 2. The average plant height (cm) at 2, 4 and 8 weeks after planting.

Method of control	Time after planting (weeks)		
	2	4	8
1 Imazapyr (2.0 kg ai/ha)	11.9 b	19.6 b	51. 3 bc
2 Glyphosate (2.5 kg ae/ha)	12.0 b	20.2 b	53.4 c
3 Glufosinate (3.0 kg ai/ha)	12.3 b	19.2 b	48.1 ab
4 Manual	10.1 a	17.2 a	44.7 a

NB: Numbers in a column followed by the same letter do not differ significantly at $P \leq 0.05$.

2. The development of leaves

The soybean performance in terms of leaf number and area is presented in Table 3.

Table 3. The average leaf number/plant and leaf area recorded 8 weeks after planting.

Method of control	Leaf	
	Number	Leaf area index
1 Imazapyr (2.0 kg ai/ha)	10.9 b	1.9b
2 Glyphosate (2.5 kg ae/ha)	9.8 ab	1.7 ab
3 Glufosinate (3.0 ai/ha)	8.6 a	1.5 a
4 Manual cultivation	8.9 a	1.4 a

NB: Numbers in a column followed by the same letter do not differ significantly at $P \leq 0.05$

The vegetative growth in terms of plant height, leaf number and leaf area indicated an excellent growth exhibited by soybean when alang-alang was controlled by imazapyr (2.00 kg ai/ha).

The growth of soybean under glufosinate was reasonable and was as good as those under manual cultivation.

3. Yield of soybean

The yield of soybean is presented in Table 4.

Table 4. The yield of soybean (kg/ha) under various techniques.

Method of control	kg/ha
1. Imazapyr (2.0 kg ai/ha)	750
2. Glyphosate (2.5 kg ae/ha)	750
3. Glufosinate (3.0 kg ai/ha)	690
4. Manual cultivation	680

The yield of soybean gave a very different picture from its vegetative growth. The yield of manual cultivation was as high as those under glyphosate treatment. Soybean grown with zero tillage when alang-alang was controlled with imazapyr was lower than manual control of glyphosate.

It was rather surprising that the vigorous growth of leaves did not produce a high yield as was expected. Plant population and calculated leaf area index did not support the contention that this low yield was due to overcrowding.

It may be worth to mention that this experiment was carried out during the very wet season, it probably affected the availability of PAR, thereby reducing the yield.

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