

EFFECT OF DIFFERENT CONTROL METHODS OF *IMPERATA CYLINDRICA* ON COCONUT (*COCOS NUCIFERA*) YIELD IN LOW COUNTRY DRY ZONE OF SRI LANKA

A D Samarajeewa, R P B S H S Senaratna and K C P Perera

Coconut Research Institute, Lunuwila, Sri Lanka

ABSTRACT

Five methods of control of *Imperata cylindrica* (L.) Beauv namely a) harrowing with disc harrow, b) Glyphosate (N- Phosphonomethyl Glycine) 2.88 kg a.i / ha, c) Glyphosate 1.44 kg a.i/ha, d) circle weeding with Glyphosate (1.44 kg a.i/ha) along with mechanical slashing rest of the area, and e) mechanical slashing were evaluated to determine the cost effective method of control of *Imperata cylindrica*, and to ascertain the effect of coconut –*Imperata* competition on yield of coconut in Low Country Dry zone in Sri Lanka. An unweeded plot was used as the control. Experiment was arranged in a Randomized Complete Block design with three replicates. Treatments were applied twice a year in six months interval. Glyphosate at the rate of 2.88 and Glyphosate 1.44 kg a.i/ha gave a significant reduction ($P < 0.05$) of weed biomass when compared to other treatments. A significant increase ($P < 0.05$) of coconut yield was observed due to control of *Imperata* in plots with these treatments at two years after imposition of treatments. When cumulative average yield of coconut was considered for three consecutive years, control of *Imperata* with Glyphosate gave a 54% increase ($P < 0.01$) of nut yield when compared to the unweeded control. Cost – benefit analysis of different control methods revealed that the application of Glyphosate at the rate of 1.44 kg a.i/ha was the most cost effective (undiscounted B/C ratio: 5.9) method of control of *Imperata* in sandy soils in the Low Country Dry Zone of the Coconut Triangle.

INTRODUCTION

Coconut is by far the most extensively cultivated plantation crop in Sri Lanka. The growth habit of the palm and its' canopy structure requires a wide spacing, which permits abundant sunlight available to the understory. As a result the unutilized space under coconut could get invaded with weeds, which compete for soil moisture and nutrients reducing the growth and yield of coconut palm and obstruct routine agronomic practices (Liyanage and Liyanage, 1992). Of the perennial grass weeds, *Imperata cylindrica* is the most noxious and troublesome weed not only in coconut plantations but also in other crop ecosystems as well (Renaldo *et al.*, 1980).

This species tolerate shade up to 50% and thrives well under mature coconut plantations (Soerjani, 1970).

Imperata is found abundantly in coconut plantations in Intermediate Dry zone of Sri Lanka, particularly in marginal coconut lands with sandy soils. The ability of *Imperata* to thrive well in marginal coconut lands particularly in sandy soils, aggravates the problem of weed competition in coconut. This emphasizes the importance of eradication of *Imperata* from coconut lands as it is an aggressive, rhizomatus perennial grass, which reproduces profusely from both seeds and rhizomes (Mercado, 1986). Of the various methods used to control *Imperata*, impact of repeated slashing and tillage, replacement of *Imperata* with leguminous cover crops and chemical methods have been reported by several authors (Mercado, 1986; Liyanage and Liyanage, 1992; Renaldo *et al.*, 1980). Although leguminous cover cropping has been reported to be the most effective method of controlling *Imperata* (Renaldo *et al.*, 1980), it is difficult to establish leguminous covers in coconut lands with sandy soils. This study envisages to find the effectiveness of use of several mechanical and chemical means of control *Imperata* and to assess the impact of coconut - *Imperata* competition on the yield of coconut.

MATERIALS AND METHODS

The experiment was conducted at *Mangalaeliya* in Puttlam District in low country dry zone of Sri Lanka from 1997 to 2000. Soil at the location was sandy and belongs to the great soil group of Sandy Regosols. The mean annual rainfall and temperatures were 1492 mm and 23.8-31.5 ° C, respectively. Following treatments were imposed.

- T1 - Harrowing with disc harrow
- T2 - Application of Glyphosate 2.88 kg, a.i. / ha
- T3 - Application of Glyphosate 1.44 kg, a.i. / ha
- T4 - Circle weeding with application of Glyphosate (1.44 kg, a.i. / ha) and slashing the rest of the area
- T5 - Mechanical slashing of *Imperata*
- T6 - Unweeded (control)

The experiment was laid in a randomized complete block design with three replicates. Each plot comprised of six effective palms of around thirty years. Slashing was done with a tractor-mounted rotary slasher while harrowing was done to a depth of 15 cm using tractor mounted disc- harrow. Spraying of weedicide was done with a knapsack sprayer. Treatments were imposed twice a year in six monthly intervals. Weed biomass was ascertained by quadrat sampling (0.5m² quadrat) followed by oven drying at 105 °C for

24 hrs. Harvesting of coconut palms in each plot was done at two monthly intervals. Total yield for a year was obtained from all six palms.

B/C ratio was used to determine the cost effectiveness of different *Imperata* control methods. Benefits were calculated as the average incremental yield per year over the *Imperata* uncontrolled, considering the yields of previous three years.

RESULTS AND DISCUSSION

Effect of different control methods on reduction of shoot biomass of *Imperata*

Figure 01 illustrates the reduction of biomass of *Imperata* due to different control methods over time. Of the various methods used, slashing in six months interval had the least effect on biomass of *Imperata*. According to Sandnam *et al.*, (1977), slashing at shorter intervals, results in better control of this weed. However slashing *Imperata* at shorter intervals in coconut lands may not be cost effective. Disc harrowing in six month- interval has reduced the biomass of *Imperata* better than slashing. This is probably due to the fragmentation of under ground parts thus, desiccation of the rhizomes. Effectiveness of control of *Imperata* by successive soil cultivation has been reported by several authors (Knows and Cole, 1973; Ivens, 1975, Mercado, 1986). Martin, (1975), has recommended successive tillage with disc harrowing at 8-10 week intervals for better control of *Imperata*.

Control of *Imperata* with Glyphosate(N- Phosphonomethyl glycine) at the rate of 2.88 and 1.4 kg a.i /ha (Counter-a.i., 356 g/l) gave a significant reduction ($P < 0.05$) of weed biomass when compared to other methods. Effectiveness of glyphosate for control of *Imperata* has been reported by several authors (Rognon *et al.*, 1984; Wrong 1971; Golan 1976; Mercado, 1986; Liyanage *et al.*, 1992). Although an integrated approach i.e. application of glyphosate followed by establishment of leguminous creeping covers was found to be effective in controlling *Imperata* (Liyanage *et al.*, 1992; Renaldo *et al.*, 1980), practical difficulties of establishment of cover crops in sandy soils in Low Country Dry Zone in the coconut triangle pave the way for the present study to opt for alternative methods of control.

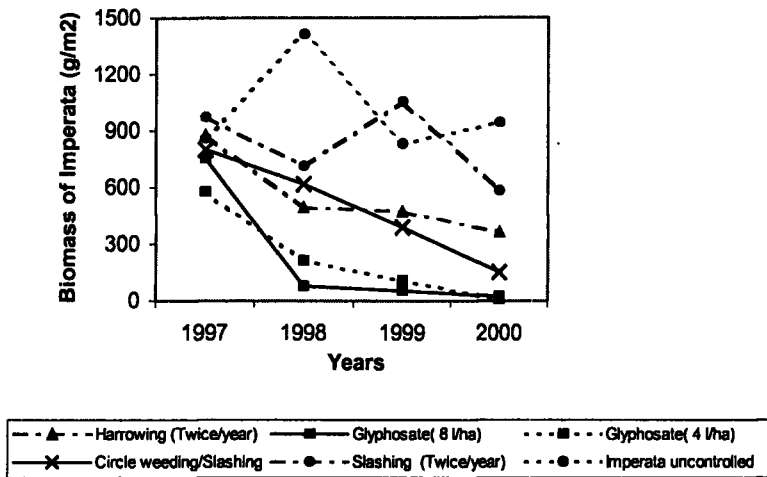


Figure1: Effect of weed control methods on biomass yield of *Imperata*

Effect of *Imperata* on yield of Coconut

Control of *Imperata* resulted in a significant increase ($P < 0.05$) in nut yield over the uncontrolled plots even a year after imposition of treatments. Impact of *Imperata* on nut yield was clearly shown after 2 years of treatment application, where increase in nut yield was 102% and 49% respectively with glyphosate treatments (average of two concentrations) when compared to unweeded control in the years 1999 and 2000. When the cumulative yield of 3 years were considered, control of *Imperata* with glyphosate has increased the nut yield by 55 %, when compared to the unweeded control. *Imperata cylindrica* is a strong competitor for soil nutrients and moisture resulting in poor growth and reduction of nut yield (Renaldo et al., 1980). Martin and Mudlier (1983) reported a reduction of copra yield by 14 % due to coconut- weed competition in general. However literature on degree of competition exerted by *Imperata* on yield of coconut is scarce.

Of the rest of the treatments, control of *Imperata* with harrowing or slashing did not contribute for a significant increase in nut yield on yearly basis (Table1). Eighty percent of the root zone of coconut is confined in the circular area with in the radius of 2m from the coconut boll (Liyanage, 1985), which is referred to as "manure circle". It is expected to keep the manure circle free from weeds to reduce the coconut-weed competition. However the present study showed that weeding in the manure circle with glyphosate has not significantly reduced the coconut- weed competition (Fig. 2) in the case of *Imperata* infestation.

Table 1: Effect of different control methods of Imperata on yield of coconut

Treatments	Year				Cumulative average yield per palm ¹
	1997	1998	1999	2000	
Harrowing	31	43	56	56	52 (18)
Glyphosate 2.88 kgs, a.i. / ha	27	45	88	72	69(56)
Glyphosate 1.44 kgs, a.i. / ha	32	54	82	65	67(52)
Circle weeding with Glyphosate	33	35	56	57	51(16)
Slahing	33	45	60	55	53(20)
Unweeded control	35	45	42	46	44
Significance	NS	*	**	*	**
CV %		10	16	13	7
LSD		9	19	14	8

NB. Values were rounded to the nearest digit.

¹Cumulative annual average yield for year 1998,1999 and 2000

* = Significance at 5 %, ** = Significance at 1% , NS = Not significant

Values in parentheses are the percentage increase of nut yield over the control

Cost/Benefit analysis of control methods of *Imperata*

Table 2: Costs and benefits of different control methods of *Imperata*

Method of control	Costs* (Rs/ha/ annum)	Average annual incremental yield/ha	Incremental benefits (Rs.) @ Rs.9.00/nut	Undiscounted B/C ratio
Harrowing	6000.00	1280	11520.00	1.92
Application of Glyphosate 2.88 kgs, a.i. / ha	9600.00	4000	36000.00	3.75
Application of Glyphosate 1.44 kgs, a.i. / ha	5600.00	3680	33120.00	5.91
Circle weeding with Glyphosate and slahing	9500.00	1120	10080.00	1.06
Slahing	7500.00	1440	12960.00	1.73

Values are in Sri Lankan Rupees (1 US\$= SLR. 102.00)

* Include material machinery and labour costs for twice a year

Average price of commercial product of Glyphosate : Rs. 400/liter (360 g a.i./litre)

Average labour wage: Rs.200/manday

The costs of different methods of control of *Imperata* are given in the Table 2. Although the highest increase of nut yield was achieved in plots treated with glyphosate at 2.88 kg of a.i. /ha, the highest returns to investment (B/C ratio: 5.9) was given by the plots treated with glyphosate at 1.44kg a.i./ha, thus making it the most effective method of control of *Imperata* among the tested treatments.

CONCLUSION

Imperata cylindrica is a strong competitor for coconut reducing, the nut yield. This study showed that control of *Imperata* with glyphosate in coconut lands with sandy soil in low country dry zone increased the nut yield by 55% when compared to that of unweeded plots. Application of glyphosate at the rate of 1.44 kg a.i (4 litres of commercial mixture; Counter-a.i., 356 g/l) found to be cost effective method of controlling *Imperata* in coconut lands in low country dry Zone.

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