Weed Management on a Rubber Plantation with Special Reference to Minimum Tillage Cultivation

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Abstract

The establishment of perennial plantations is a process of vegetational succession. The succession will favour the development of "weeds" as considerable resources are utilized by the almost unlimited number of weeds, compared to only about 500 plantlets/ha, therefore, weed control or vegetation management is necessary to orient the succession into vegetational domination of a good perennial plantation.

Problems of weeds exist in every stage of crop establishment, from pre-planting, nursery, immature, and mature rubber fields. Therefore, it is imperative that weed management strategies/activities address the problem.

Crop establishment using minimum tillage cultivation will necessitate the classification of types of vegetation into those which are useful (A) and whose growth should be encouraged, those which are harmless (B), those which are useful soil cover as soft grasses (C), those that should be controlled (D), and those which should be eradicated (D).

Weed control activities are directed only toward certain species of weeds, leaving others to grow to be manipulated for the benefit of the plantation.

Introduction

Weed management especially in perennial crops is more a problem of vegetation management, i.e. a system of planned and responsive activities to promote the establishment of perennial crops by directing the process of vegetational succession from an undesirable course of development toward a desirable one, so that the vegetation in the area is dominated by rubber in the shortest possible period. It is understood from the onset that the condition immediately before or after manipulation is not usually the desired one and that through the anticipation of vegetation succession we set up vegetation communities to grow into a desirable form. Thus, a given manipulation of vegetation as intermediate objective has the appearance of a limited number of crops that will develop into a stand deemed desirable (Miles, 1979).

The development of vegetational succession in perennial plantations is dependent upon physico-chemical and biotic factors such as stability of vegetation community before the establishment of perennial crops, edaphic as well as climatic suitability for introduced crops, abundance of other vegetation types and juvenile growth habit of the crops (Newton, 1981).

The conditional requirement that the rubber plant domination should occur in the shortest possible time implies a set of activities which should be programed and executed to orient the process of succession toward the domination of rubber plantation in the form of healthy rubber plantation.

The planned and responsive activities will cover various subject matters, such as :

(a) Those related to pre-planting,
(b) Those related to nursery,
(c) Those related to rubber field.

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Pre-planting

1. Field preparation

The first problem faced by the plantation manager at the pre-planting stage is the stability of the existing vegetation community. Stability, in the ecological sense, is the resistance to change in composition. There is a trend for plant communities to become more stable as they increase in age. With increasing degree of site occupation, there is a decreasing chance for the establishment of immigrant seedlings (Odum, 1969; Eussen, 1981). Abundant recruitment of new plants tends to occur only after a substantial disturbance (Miles, 1979; Nearing and Goodwin, 1976). Therefore, if a community has stabilized in an undesirable stable state it must be disturbed to dislodge it and we are thus left with the basic principle that stability is a natural property of plant communities and that disturbance of some kind is a prerequisite for a change in the trend of successional development. A logical corollary of this principle is that the need for intensive disturbance increases as successional stages mature.

The planning of the field layout has a strong bearing on weed control and management during preparation, planting, even for tapping. The size of unit fields with the accompanying road and drainage systems is a very important factor to consider.

The areas for planting are differentiated into :

(a) Forested land
(b) *Imperata* land, and
(c) Old plantation

1) Forested land

Forested land refers to primary and secondary forests. The primary forest consists of trees with three or four storeys. The top storey is scattered, not forming a continuous cover but emerging here and there out of very large, buttressed trees over 50-70 m in height. The lower storey occurs at 30-50 m. Below the mature tree storey there is a large zone of young sapling trees, and below this a scanty undergrowth (Jacobs, 1988; Budowsler, 1965). In secondary forests, undergrowth is much more abundant, although the population of trees is lower but the methods used for clearing these forests do not differ appreciably.

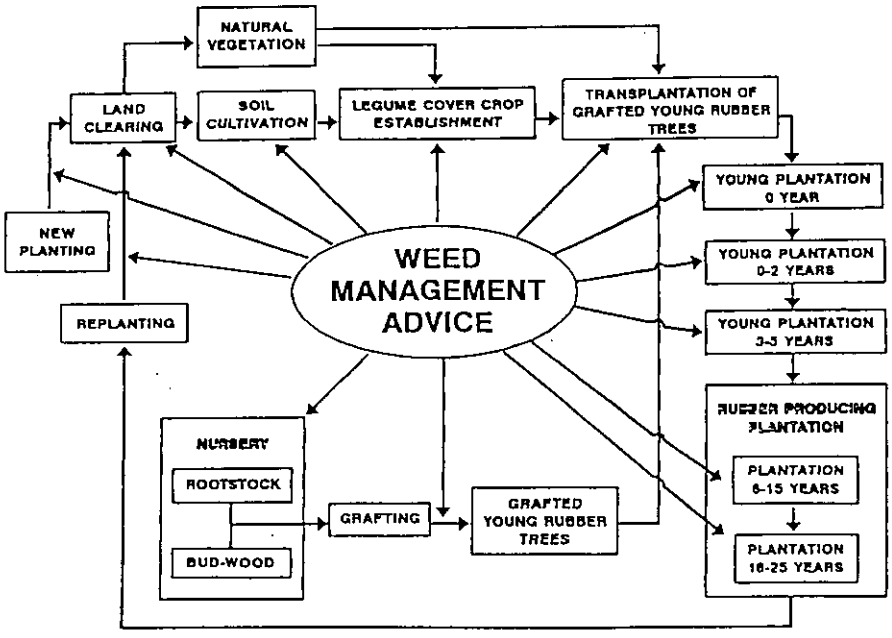

Fig. 1 Diagram showing the relationship of various activities and points where weed management advice is required (Tjitrosemito and Mawardi, 1993)

Plant nutrients in a forest system are held in the vegetation and surface soil, and the good structure of the humic topsoil is protected from the impact of rainfall and sunlight by the closed forest canopy and by the deposited litter so that rainfall readily infiltrates into the soil. The disruption of stability for crop establishment should also be considered. When the land is cleared and the bare soil is exposed to the sun and to the impact of rainfall, the decomposition of soil organic matter will be accelerated, leading to nutritional leaching, breakdown of the aggregate structure of the surface soil and erosion of the nutrient-rich soil surface. To avoid these ill-effects as far as possible, the exposure of the bare soil should disturb and compact the soil as little as possible (Webster and Baulk-will, 1989).

The availability of land for establishing a rubber plantation is decreasing and flat land is being utilized for expanding food crop production as some areas previously used for food production have been converted to residential areas and also factories in the process of urbanization.

Therefore, the accepted area for the establishment of a rubber plantation has been extended to lands with a slope of 45°. Lands with a slope of more than 45° should not be considered for establishing rubber or other plantations but as continuous cover. However, whenever sloping lands are utilized for plantation, necessary water and soil conservation works should be undertaken.

Land clearing may be carried out according to the following sequences :

a) Cut all undergrowth with "parang" , fell trees with chainsaws, smaller first close to the ground, bigger ones 0.5–1.5 m above ground, buttressed trees 2.0 m above ground ; uproot stumps. It requires 150–200 mwd/ha (man working days) for 200 trees/ha or when bulldozers are used 5 twh/ha.
b) Line-felled trees should be in one direction parallel to the intended rubber rows and these operations are normally executed in March-April (i.e. at the end of the wet season).
c) Leave unsaleable materials to dry out by stacking and windrowing before burning in July-August.
d) Remove stumps, roots and other debris in advance.
e) Construct the necessary soil conservation device, drainage and road systems.

Up to this point, if the area was formerly primary forest, weed infestation will be minimal, but in the case of secondary forest, the amount of shrubs can be considerable, and these shrubs together with robust, big grasses (*Themeda* sp., *Saccharum* sp., *Imperata cylindrica*) should be eradicated before legume cover crops are planted.

Table 1 *Imperata* population before and after treatment (plant/m²) and at harvest (% coverage) after some treatments and one season cropping

Treatments	Initial[3] population (plant/m²)	At 8 weeks[3] after spraying (plant/m²)	At planting[1] (plant/m²)	After maize and rice harvest[2] (% coverage)
1. Mechanical control	53.7	22.5 b	19.3 b	28.3 ab
2. Manual	44.2	27.3 b	18.9 b	35.0 b
3. Minimum tillage				
a. Dalapon (6.8kg ai/ha)+ 10kg Urea + 11 Teepol			5.8 a	22.5 a
b. Glyphosate (2.2kg ai/ha)	68.7	3.5 a	3.9 a	17.5 a
4. Zero tillage, glyphosate (2.2kg ai/ha)	58.8	3.5 a		
LSD	ns	8.3	3.1	5%
C. V.		(−)	20.0	23.9

1) adopted from Tjitrosemito *et al*., 1985
2) adopted from Mangoensoekarjo *et al*., 1987
3) adopted from Siswanto and Anwar, 1986

2) *Imperata* land

The land slope requirement is the same as that of forested land. Generally works on land clearing under *Imperata* are much easier than those under forested land. *Imperata* land is sometimes considered as **fire climax**, i.e. it has a strong stability. Therefore, it is necessary to disrupt this stability for providing opportunities to the introduced rubber stumps to grow and dominate the area. Chemical control using herbicides such as glyphosate (2.2 kg a.i./ha) or dalapon (8+7 kg a.i./ha) should be observed carefully since there is always regrowth from the remaining *I. cylindrica*. The typical results of spraying as compared with other methods are depicted in Table 1.

Spraying as soon as indicated in Table 1 is consistenly very effective, but still leaves a considerable *Imperata* population, which necessitates the application of spot spray and wiping. Wiping may be done using 1% glyphosate, or 2% dalapon, or diesel oil + kerosene in a 60 : 40 mixture.

Recently imazapyr has also been applied. Normally one month after spraying is required before a legume cover crop (LCC) can be planted.

However, when *Imperata* is killed, the growth of weed seeds from unshaded soil will be very fast. It is important therefore to control emerging weeds in the growing legume cover crop. It requires clean weeding at 2-week intervals with 8-20 men working days/ha.

3) Old plantation (replanting and conversion planting)

As weeds grow weaker under the shade of an old plantation and are easier to control than when they grow under full sunlight, it is suggested that weeds should be controlled one year before filling.

When the incidence of "White root disease" (*Rigidoporus lignosus*) is high, it is preferable to cultivate the soil and remove from the area debris of plant roots and stumps. This condition is also beneficial for the establishment of legume cover crops. However, the lower loss of trees and the saving in disease control measures after planting may not offset the high cost of stump and root removal compared with minimum tillage technique. In such a situation soil cultivation with accompanying stump and root removal is not recommended.

The vegetation under old plantation may be classified into the following groups (Nasution, 1986; RRIM, 1972):

A. Useful weeds or vegetation, the growth and establishment of these plants should be encouraged.
B. Harmless annual vegetation, in a normal situation no special effort to control these plants is necessary.
C. Perennial vegetation, usually tolerated as "soft grasses", but when excessive will require a particular control.
D. Very competitive weeds, should be controlled especially at the early stage of establishment of young rubber.
E. Noxious weeds, should be eradicated.

The vegetation may be dominated by either of those groups, or most likely they grow together with groups D and E dominating the vegetation when the plantation is kept with only minimum maintenance.

Initially weeds of groups E and D are normally eradicated one year after rubber tree felling. Weeds of D and E groups consisting of shrubs and woody weeds are normally eradicated first. When the density is low, it is sufficient to uproot them manually; however, when the density is high, Picloram (TORDON 101) at 4-6 l/ha or trichlopyr at 1.2-2.4 kg a.i./ha could be applied. For weeds of D and E groups consisting of grasses, glyphosate at 1.2-1.5 kg a.i./ha is sufficient. For the weeds of ABC groups, when the density is low to high, paracol at 1.5 l/ha will be sufficient to prevent them from growing, until LCC planting is carried out; however when the density is high, they will require glyphosate at 3 l/ha to keep them in check. In sloping land, terracing and other soil conservation measures should be applied (see under forest land) beside the conservation of a road network.

After eradication of D and E weeds and felling of rubber trees, lining and holing, i.e. preparation for planting should immediately follow. Legume cover crops are planted in between rows of holes.

A typical series of operations, when the area is less than 200 ha can be seen in Table 3.

Table 2 List of common weeds in rubber plantation (Modified from Sri S. Tjitrosoedirdjo, 1993)

Group/Family	Species	Class
FERNS (Pteridophyte)		
1	*Blechnum orientale*	B/C
2	*Cyclosorus aridus*	B/C
3	*Dicranopteris linearis*	D
4	*Lygodium flexuosum*	B
5	*Nephrolepis biserrata*	C
6	*Selaginella willdenowii*	B/C
7	*Stenochlaena palustris*	B/C
8	*Taenitis blechnoides*	B/C
GRASSES (Poaceae)		
1	*Axonopus compressus*	C
2	*Brachiaria distachya*	D
3	*Brachiaria reptans*	D
4	*Centhotheca lappacea*	D
5	*Coelorachis glandulosa*	D
6	*Cynodon dactylon*	C
7	*Cyrtococcum acrescens*	C/D
8	*Cyrtococcum oxyphyllum*	C/D
9	*Dactyloctenium aegyptium*	B/C
10	*Digitaria ciliaris*	B/C
11	*Echinochloa colona*	C
12	*Eleusine indica*	B
13	*Imperata cylindrica*	E
14	*Ischaemum muticum*	B
15	*Ischaemum timorense*	B
16	*Ischaemum rugosum*	D
17	*Oplismenus compositus*	D
18	*Ottochloa nodosa*	C
19	*Paspalum cowersonii*	D
20	*Paspalum conjugatum*	C
21	*Pennisetum polystachion*	D/E
22	*Setaria barbata*	D/C
23	*Setaria palmifolia*	D/E
24	*Sporobolus diander*	D
25	*Themeda arguens*	D/C
26	*Themeda villosa*	D/E
SEDGES (Cyperaceae)		
1	*Cyperus kyllingia*	C
2	*Cyperus rotundus*	D
3	*Scleria bancana*	D
4	*Scleria ciliaris*	D
5	*Scleria levis*	D
6	*Scleria sumatrensis*	D

(Table 2 continned)

(Table 2 continned)

Group/Family	Species	Class
	7 *Scleria purpurescens*	D
CLIMBERS		
	1 *Abrus precatorius*	C
	2 *Calopogonium mucunoides*	A
	3 *Centrosema pubescens*	A
	4 *Cardiospermum halicacabum*	C
	5 *Desmodium triflorum*	A
	6 *Dioscorea nummularia*	C
	7 *Ipomoea cairica*	C
	8 *Lepistemon binectariferus*	B
	9 *Melothria affinis*	B
	10 *Merremia umbellata*	D
	11 *Mikania micrantha*	E
	12 *Passiflora foetida*	B
	13 *Pueraria javanica*	A
	14 *Tetracera indica*	D
	15 *Tetracera scandens*	D
	16 *Trichosanthes walliciana*	D
	17 *Vitis japonica*	D
SHRUBS		
	1 *Chromolaena odorata*	D
	2 *Clibadium surinamense*	D
	3 *Clidemia hirta*	D
	4 *Cordia curassavica*	D
	5 *Diodia sarmentosa*	D
	6 *Ficus hirta*	D
	7 *Grewia tomentosa*	D
	8 *Lantana camara*	D
	9 *Melastoma affine*	D
	10 *Sida rhomboidea*	D
	11 *Sida acuta*	D
	12 *Triumfeta rhomboidea*	D
	13 *Urena lobato*	D
MIMOSACEAE		
	1 *Mimosa invisa*	E
	2 *Mimosa pigra*	E
	3 *Mimosa pudica*	D
HERBS		
	1 *Ageratum conyzoides*	B
	2 *Ageratum haustonianum*	B
	3 *Borreria laevis*	C
	4 *Borreria latifolia*	C
	5 *Cleome rutidosperma*	B
	6 *Commelina benghalensis*	C
	7 *Commelina diffusa*	C

(Table 2 continned)

Group/Family	Species	Class
8	*Crassocephalum crepidioides*	B
9	*Croton hirtus*	B
10	*Curculigo villosa*	C
11	*Desmodium triflorum*	A
12	*Dianella nemerosa*	B
13	*Emilia sonchifolia*	B
14	*Euphorbia hirta*	B
15	*Euphorbia heterophylla*	C
16	*Hyptis capitata*	D
17	*Hyptis brevipes*	D
18	*Phylanthus amarus*	B
19	*Phylanthus reticulatus*	B
20	*Rostellularia obtusa*	B
21	*Stachytarpheta indica*	D
22	*Trimeza martinicensis*	B

2. Lining and holing

When the area is cleared of trees, shrubs, and robust grasses, lining and holing can be carried out. When the area is flat, line marking is easier. Usually a base line is fixed on the longest boundary of the area, running from north to south. The base line is made with the help of a steel wire tagged according to inter-row distance by extending it from a corner peg and placing a second corner peg at its end and other pegs are then put on the base line at each planting point marked on the wire. In the east-west direction another guide perpendicular to the base line is fixed and tagged at row distance. Starting from the base line, the wire of inter-row distance is held at its north and south ends by two men who advance in the east-west direction. They stop at each tag on the guide line, while other men place pegs at the planting point along the wire.

When the area is sloping, the planting rows are established on terraces to follow contour lines. The distance from center to center of adjacent terraces is equal to the normal inter-row distance under flat conditions. A base line is marked out at right angle to the contour, down an average slope of the area. Pegs are put in at the inter-row planting distance down the length of the base line. As the slope is usually not uniform, when the distance between terraces is reduced by 2/3 of the normal distance the terrace is terminated; if the distance is more than or equal to 4/3 of normal, an additional terrace should be prepared; when the slope is more than 30%, the plants are planted on individual terraces.

Holes are made using cangkul measuring 60 x 60 cm at the surface, tapered down to 40 x 40 cm at 50 cm depth. In each hole, 300 g of rock phosphate is introduced.

3. Establishment of LCC

When the availability of labour is low, LCC is planted one year ahead of crops. However when the area is only small and the availability of labour is high, LCC and crops can be planted in the same year.

There are many species of legume cover crops such as *Pueraria javanica, P. phaseloides, Calopogonium mucunoides, C. caeruleum, Centrosema pubescens*, etc.; but in Lampung and West Java *P. javanica* (at 7.0 kg/ha) and *C. caeruleum* (1 plant/m) are very common. *P. javanica* is planted in 4 rows, i.e. 2 rows are at 1.5 m distance from the rubber rows, the next row is 1.0 m apart with a central row planted with *C. caeruleum*. *P. javanica* is planted at about 122.5 g/m row and mixed with an equal amount of rock phosphate. Cutting of *C. caeruleum* is fertilized with 10 g rock phosphate/plants and planted at 1.0 m distance.

Nursery

In the nursery, the planters have the greatest opportunity to obtain the best planting materials through careful selection and appropriate agronomical practices. If farmers do not utilize this opportunity properly and plant second grade budded stumps, they will experience a considerable loss in entrepreneurship in the form of high cost of maintenance with associated low yields.

There are two nurseries, i.e. for rootstocks and budwood. The strict selection of plant materials from seeds, seedlings, grafting, bud form, vigor and careful husbandry on the best environment, with adequate moisture and nutrients, free of weeds, pathogens, insect and vertebrate pests will ensure healthy, vigorous and strong budded stumps. It is the first pre-requisite for a good rubber plantation.

1. Rootstock nursery

The process of establishing a rootstock nursery involves a series of activities including construction of germination bed, germination of selected seeds, transfer of seedlings to a nursery with a selected site, maintenance of seedlings for 4-6 months (for green-budding) or 8-12 months (from brown-budding) until grafting with the appropriate scion.

The site for rootstock nursery must be carefully selected, cleared from other vegetation types, thoroughly cultivated and kept weed-free until seedlings are planted in 40 x 40 cm double rows; row distance is 60 cm. Seedlings are planted in holes 5 cm deep.

Weed management is directed toward clean-weeding in every step of those series of activities.

Table 3 Integrated *Imperata* control into other activities before rubber planting in PTP XI West Java (Adopted from Tjitrosemito and Mawardi, 1993)

No.	Activities	J	F	M	A	M	J	J	A	S	O	N	D
1.	Delineating field	x	•	•	•	•	•	•	•	•	•	•	•
2.	Fell big trees	x	x	•	•	•	•	•	•	•	•	•	•
3.	Slashed shrubs	•	•	x	•	•	•	•	•	•	•	•	•
4.	Uproot shrubs	•	•	x	•	•	•	•	•	•	•	•	•
5.	Uproot big trees	•	•	•	x	•	•	•	•	•	•	•	•
6.	Windrowing-burning	•	•	•	x	•	•	•	•	•	•	•	•
7.	Spray ***Imperata***[1]	•	•	•	•	•	x	•	•	•	•	•	•
8.	Correction spray[2]	•	•	•	•	•	•	x	•	•	•	•	•
9.	Spot-spray ***Imperata***[3]	•	•	•	•	•	•	•	•	x	•	•	•
10.	***Imperata*** hunting[4]	•	•	•	•	•	•	•	•	•	•	•	• x
11.	Road construction	•	•	•	•	x	•	•	•	•	•	•	•
12.	Drainage construction	•	•	•	•	x	•	•	•	•	•	•	•
13.	Lining	•	•	•	•	•	•	x	•	•	•	•	•
14.	Soil conservation/terracing	•	•	•	•	•	•	•	x	x	x	•	•
15.	Holing	•	•	•	•	•	•	•	x	x	x	•	•
16.	Weeding before planting LCC[5]	•	•	•	•	•	•	•	•	x	•	•	•
17.	Weeding after planting LCC	•	•	•	•	•	•	•	•	•	•	•	•
18.	Circle weeding	•	•	•	•	•	•	•	•	•	•	•	• x
19.	Pest/disease control	•	•	•	•	•	•	•	•	•	x	•	x
20.	Fertilization of LCC	•	•	•	•	•	•	•	•	•	•	•	x
21.	Planting LCC	•	•	•	•	•	•	•	•	•	•	x	x
22.	Planting rubber	•	•	•	•	•	•	•	•	•	•	x	x
23.	Fertilization of rubber	•	•	•	•	•	•	•	•	•	•	•	x

1: using glyphosate at 1.44kg a.i./ha
2: using glyphosate at 0.36kg a.i./ha
3: using glyphosate at 1.1kg a.i./ha
4: wiping glyphosate at 1 %
5: using glyphosate at 1.1kg a.i./ha (against grasses other than *Imperata*)

Greater attention should be given when seedlings have been transferred to the nursery. Weed control rotation must be adhered to closely. Manual weeding should be performed once every 10 days in the first month, once every 15 days in the second and third months, and once at monthly intervals from the fourth month onward until grafting. However, when labour is scarce, chemical control can also be applied, i.e, mixture of alachlor + linuron at 0.5 kg a.i./ha each at 1-5 days after planting is adequate for about 3 months; thereafter paracol (paraquat + diuron 0.5 kg a.i./ha at 2 monthly intervals is sufficient (Yeoh *et al*., 1980). Care should be taken to avoid herbicide contact with the stem and leaf of young rubber trees.

2. Budwood nursery

This nursery is directed toward producing a sufficient amount of scions to be grafted onto young rubber trees from the rootstock nursery. The planting materials in the form of stumps are planted at 100 x 80 cm. The size of the nursery has to be calculated carefully to ensure a sufficient quantity of scions to be grafted. One year old budwood will produce 20 scions/m; budwood rubber 1.5 years old having experienced cuttings twice will produce 6-8 new branches, each having 3-4 good scions. As the planting distance is wider than that in the rootstock nursery, weed management in more laborious; basically it is similar to that of root-stock nursery in that it requires also clean weeding.

3. Grafting

There are two types of grafting available, brown and green budding. The technique is similar, the latter one has been carried out recently, and is more difficult, but can be performed on rootstock only 4-6 months old. The success of grafting is markedly affected by the soil moisture conditions and when evaporation is leading to water deficit, grafting should be postponed until the soil moisture is more favourable.

The maintenance of grafted rootstock may be carried out "in situ" or it may be planted in polybags before being transplanted to the field. Planting of the budded stump in polybags is preferable, because more maintenance must be carried out to ensure a good planting material in the field.

Weed management is directed toward clean weeding both for weeds in the polybags as well as the surrounding.

Field plantation

When the intended field for establishing a rubber plantation has been thoroughly prepared and the budded stumps either directly from the rootstock nursery after being grafted, or in polybags are available in sufficient quantity, then transplanting can be carried out.

Transplanting is carried out carefully by considering the topography, planting distance, as well as whether a legume cover crop (LCC) is planted. Planting distances vary from 4 × 5 m to 7 × 3 m or 8 × 2.5 m with a population of around 500 budded stumps/ha.

In any case weed management activities can be differentiated into those of rubber plantation at:

1) 0 - 2 years old,
2) 3 - 5 years old,
3) 6 - 15 years old and
4) 16 - 25 years old

1. Rubber plantation 0-2 years old

The activities for weed management are extremely important here. The introduced budded rubber stumps number only around 500 plants/ha, and yet the weed population is almost unlimited. It is compulsory, therefore, to control the vegetation adequately to provide enough opportunity for rubber stumps to grow, develop and dominate the environment.

The area is usually differentiated between (1) the circle around the introduced rubber and (2) outside the circle. The circle of 1.0-1.5 m in radius around the young rubber should be free of weeds; and weeding is usually carried out manually through light soil cultivation 10-12 times per year requiring 3-4 MWD/ha. While it seems to require a tremendous labour input, the input will be much higher when at this stage weed management is neglected.

Outside of the circle, the vegetation should be managed adequately. When LCC is planted, it is recommended to adapt the following rotation, performed manually by pulling and uprooting the weed: 1 st-6 th month requires 8-15 MWD/ha, 6 th-12 th month requires 5-6 MWD/ha, 12 th-24 th month requires 4 MWD/ha.

When weeds of D and E types are present abundantly, the plantation is in a very bad condition. A mistake has been made along the line somewhere during the pre-planting stages, either cultivation in nursery or negligence in later plantation husbandry. In any case weeds of D and E types must be eradicated.

Imperata cylindrica and other unwanted grasses can be controlled using glyphosate at 2.0-4.0 kg a.i./ha when there is a dense to very dense population with blanket spray (dense) or spot spray (very dense); when the density of the population is low, wiping using glyphosate 1 %, dalapon 2 % , or diesel oil + kerosene mixture at 60 +40 is preferable, while shrubs may be uprooted or sprayed with picloram or triclopyr at 1.2-2.4 kg a.i./ha.

2. Rubber plantation 3-5 years old

At this stage the growth of the rubber plantation when kept normally at least will consist of trees with a girth of 8.0 - 10.0 cm. The circles of each tree are joined to form a strip along the row of rubber trees.

Weed control in strip, or rows, will be much more intensive before manuring. As at this stage the population of weeds in the strips has increased also, chemical control is usually more frequently applied. Weed management in-between rows is directed toward the eradication of D and E types of weeds.

3. Rubber plantation 6-15 years old

When the standard practice of plantation husbandry is carried out normally at this stage the plantation should be adequate. The canopy is closing reducing the light penetration. When the population of LCC is reduced, so is the population of weeds. As rubber also experiences leaf falling during the dry season, the population of D and E types should always be observed.

4. Rubber plantation 16-25 years old

The strip weed population still requires control, weeds of D and E types are not allowed to grow, but toward the 20 th year the vegetation is allowed to grow in-between rows as at this stage the rubber is close to replanting again.

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