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**INTEGRATED WEED MANAGEMENT IN TEA**

(This Advisory Circular supersedes Advisory Circular WM 1 Serial No. 03/13 issued in 2013.  
Also this cancels Advisory Circulars WM 2 and WM 3 Serial Nos. 10/03 and 11/03, issued in July and  
September 2003 respectively)

**1. Introduction**

Weeds are any plants that grow where they are unwanted or out of place and they interfere with tea grower's objectives. There are different types of weed species, in tea fields. The weed species present in tea lands are summarized in Table 1 based on their morphological classifications.

Table 1: Weed Species present in Tea Lands

Broad leaf	<i>Ageratum conyzoides</i> (Hulanthala), <i>Asystasia gangetica</i> (Puruk- kola), <i>Bidens pilosa</i> (Ottu-pillu), <i>Caladium bicolor</i> (Mal Habarala), <i>Commelina diffusa</i> (Girapala), <i>Crassocephalum crepidioides</i> (Thandum- pillu), <i>Erigeron sumatrensis</i> (Alawungu- pillu), <i>Lantana camara</i> (Ganda-pana), <i>Leucas zeylanica</i> (Geta-tumba), <i>Miconia crenata</i> (Wal-Bovitiya), <i>Osbeckia octandra</i> (Heen-bowitiya), <i>Persicaria capitata</i> (Ratu kimbulwenna), <i>Phyllanthus debilis</i> (Ela pitawakka), <i>Scoparia dulcis</i> (Wal-koththamalli), <i>Sida acuta</i> (Gas-bebila), <i>Solanum americanum</i> (Kalu kun- berriya), <i>Spermacoce ocymifolia</i> (Geta-kola), <i>Sphagneticola trilobata</i> (Arunadevi) etc.
Grasses	<i>Cenchrus setosus</i> (Nari - naguta), <i>Chrysopogon aciculatus</i> (Thuththiri), <i>Digitaria abyssinica</i> (Heen Etawara), <i>Eleusine indica</i> (Belathana), <i>Imperata cylindrica</i> (Illuk), <i>Megathyrsus maximus</i> (Gini-thana), <i>Panicum repens</i> (Etor), <i>Panicum trichocladum</i> (Kambi-thankola), <i>Setaria barbata</i> (Wal thal kola) etc.
Sedges	<i>Bulbostylis barbata</i> (Uru-Hiri), <i>Cyperus aromaticus</i> , <i>Cyperus brevifolius</i> , <i>Cyperus mindorensis</i> (Mottu Thana), <i>Cyperus rotundus</i> (Kalanduru), <i>Cyperus sesquiflorus</i> , <i>Fimbristylis sp.</i> etc.

Weeds in tea lands could interfere with the growth of tea by competing for light, space, nutrients and water, thus affecting the productivity. A dense weed cover could also interfere with routine field practices such as fertilizer application, plucking, pruning, forking etc., and, could also serve as alternate hosts for some tea pests and disease organisms.

**2. Build-up of Weeds**

The abundant occurrence of weeds in tea fields could be attributed to factors such as extensive areas of exposed soil resulted from poor bush stand, high rainfall, delayed weed control rounds and surrounding neglected areas serving as weed seed-banks. The introduction of weed seeds and vegetative parts with applied compost and mulch, and resorting continuously to a single herbicide that could lead to resistance development, are other attributes for such development. A general understanding of the possible causes for weed build-up is important for the tea grower to select and integrate two or more of the appropriate weed management methods.

### **3. Integrated Weed Management Methods**

Weed management in tea lands has to be achieved in an integrated manner. The various practices adopted include manual, mechanical, chemical, cultural / ecological and biological methods. Amongst, preventive measures following above methods are very important as their adoption could help to minimize the cost of weeding.

Integrated Weed Management (IWM), refers to a combination of some or all the above methods, in a rotational manner throughout the year. IWM utilizes the available know-how on weeds and their management to achieve cost-effective and eco-friendly weed control (Figure 1).

#### **3.1 Weed Control Calendar**

The decision-making process for weed management in tea is based on the weed control calendar prepared for different regions according to the rainfall pattern, growth stage and bush cover of tea (Figure 2).

In order to prevent build-up of resistant weed species, maintain the number of herbicide applications for the year to a minimum (maximum two from a single herbicide), and use a range of herbicides of different mode of action in rotation than continuing with a single herbicide.

#### **3.2 Special Considerations**

In order to arrive at effective weed management method/s, due consideration should be given to cost factor, impacts on soil and environment, bush cover and growth stage of tea and the possible risk of building up of resistance in weeds *etc.* Effective weed management also depends on the accurate identification of weeds (Table 1) and basic understating of their life cycle.

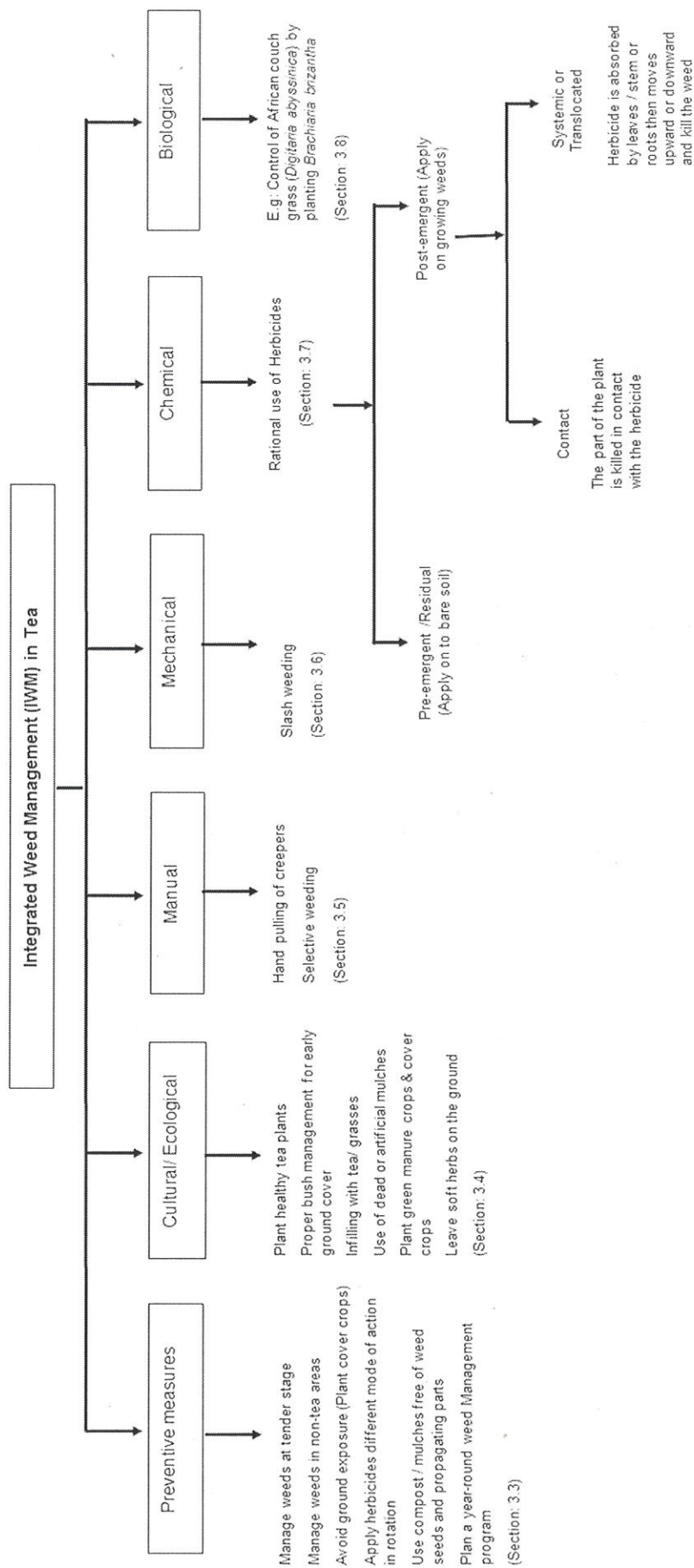


Figure 1: Integrated Weed Management (IWM) Strategies in Tea



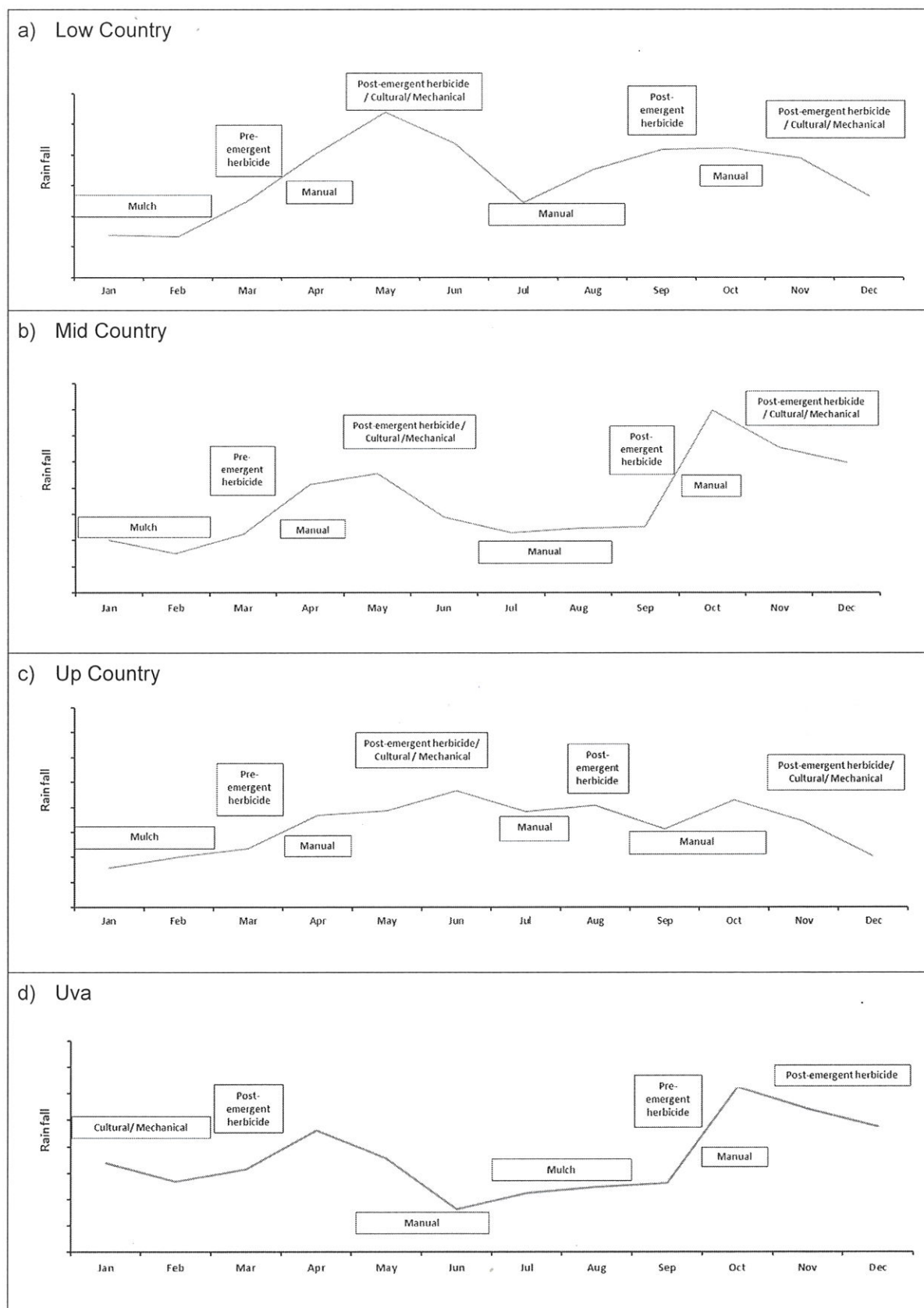


Figure 2: Weed Management Calendars for different tea growing regions

### 3.3 Preventive Measures

The objective of adopting preventive measures is to minimize accumulation of a seed bank i.e., weed seeds and propagules in tea lands. It would in turn assist in lowering the cost of management of the present and future weed population in tea fields. Appropriate preventive measures that could be adopted are as follows:

- Undertake weeding when weeds are in tender and before the stage of flowering (mature stage).
- Keep boundaries of tea fields, roadsides, ravines and other areas adjacent to tea fields free of weeds to prevent the continuous dispersal of weed seeds into tea fields. Any over-grown weeds in such areas should be kept slashed or in the alternative to prevent seeding for keeping them under check.
- Plant cover crops in all exposed areas and utilizing uncultivated areas for thatch banks, or forestry, to suppress indiscriminate weed growth.
- Adopt a year-round weed management programme using weed management calendar appropriate to the region for timely attention.
- Use compost and mulching materials in a more rational way, by taking due care not to bring weed seeds and other vegetative parts such as rhizomes, yams, propagules *etc.* that are capable of regeneration into tea fields.

### 3.4 Cultural / Ecological Weed Control Methods

The objective of adopting cultural / ecological techniques is to enable quick establishment of proper ground cover of land, to suppress the growth of weeds. This could be achieved by adoption of following practices;

Infilling vacant patches in tea fields with quick growing, early spreading cultivars that would attain a quick ground cover and thereby shade out the weeds. In old tea fields, where the vacancies are not expected to be infilled in near future, a suitable grass such as Mana (*Cymbopogon confertiflorus*), Guatemala (*Tripsicum laxum*), Hybrid napier CO-3 (*Pennisetum perpureum* X *Pennisetum americanum*) or Vetiver (*Chrysopogon zizanioides*) grass may be planted to avoid such vacant patches becoming breeding grounds for weeds. These grasses will suppress weeds due to their smothering and allelopathic effects.

Planting of green manure crops, such as *Crotalaria micans* (Adanahiriya), *Tithonia diversifolia* (wild sun flower), Wild chrysanthemum / Mari Kolundu (*Artemisa vulgaris*) or *Flemingia macrophylla* in vacant patches and as a hedge row for thatching in tea fields is also useful. Cover crops such as Mal ratakaju (*Arachis pintoii*) could also be planted on two feet wide strips in middle of the tea inter rows and Eth undupiyalaiya (*Grona ovalifolia*) and *Indigofera* sp. in non-tea areas such as roadsides, borders, abandoned lands *etc.*

Using suitable (i) mulching materials such as Mana, Guatemala, Godapara (*Dillenia suffruticosa*), *Flemingia macrophylla* *etc.* (ii) artificial agriculture mulch could be used to cover the inter-row spaces as effective mulching sources.

Adoption of all possible measures to encourage the early development of frames in the tea bush and maintaining bush stand is essential in minimizing the potentials of weed emergence. This could be achieved using healthy and well spreading nursery plants in new clearings, proper infilling programs, adoption of Good Agricultural Practices ensuring implementation of timely bringing-into-bearing to enhance spread of peripheral branches of the bush.



### 3.5 Manual Weeding

Manual weeding could be undertaken either by exclusively “hand-pulling” weeds or by “slash weeding”, as described below:

Hand pulling is the removal of weeds totally by hand. Although a costly operation, it is a safer method than chemical weeding.

Clean weeding by using a scraper should be strongly discouraged. Selective weeding should be advocated, where shallow rooted soft herbs such as *Centella asiatica* (Gotukola), *Drymaria cordata* (Kadalai kodi), *Grona triflora*, (Heen undupiyaliya), *Euphorbia scordiifolia* (Heendada keeriya), *Oxalis* sp. (Ambul ambiliya), *Stemodia verticillata*, *Mollugo pentaphylla* etc. which are beneficial are retained to serve as a live ground cover.

Digging the soil to remove tuberous or rhizomatous weeds is not advocated because such practice could aggravate weed infestation arising through regrowth of fragmented underground plant parts that are capable of regeneration.

Weeds that are resistant to herbicides should be hand pulled, along with other free-growing weeds.

All creeping weeds such as *Anredera cordifolia* (Passali kodi), *Camonea pilosa* (Maha-Madu/Kiri-madu-vael), *Ipomoea* sp. (Railway glory/ Morning glory), *Mikania* sp. (Watupalu/Lokapalu), *Neustanthus phaseoloides* (Pohora- wel), *Xenostegia tridentata* (Heen madu wel) etc. should be removed manually.

All the weeds that are removed from a tea field should be piled up in a wooden cage within the tea block. It is necessary to mix up the heap once in a while, to check and remove re-growing tuberous, rhizomatous weeds. Weeds should be used for composting only after picking out the yams, bulbils and other vegetative parts capable of regeneration, and destroying them.

### 3.6 Mechanical Weeding

Slash weeding is the removal of weeds by cutting them at the base with a hoe/cutter in mechanical weeder. Woody, grass and deep-rooted perennial weeds, that resist removal by hand or herbicide, should be slashed. Continual slashing will result in a gradual decline in weed seed population in the soil.

Mechanical Weeding using grass cutters (with a proper guard) is more suitable for tea lands with large vacant patches.

It should be noted that recovery of weeds is faster with continual use of slashing.

### 3.7 Chemical Weed Control

Chemical weed control among other various weed management techniques available under IWM is economically important in tea. Selection of herbicides should be based on the type of weed species, growth stage of tea, growth cycle of weeds and the weed control calendar introduced to respective regions. Precautionary measures should be adopted in the use of herbicides to avoid any non-target effects to the crop, humans and the environment.

Please refer to Advisory Circular PU 3 for details of different herbicides recommended for tea, modes of action, dosages and precautionary measures.

### 3.8 Biological Weed Control

Biological weed control is defined as an activity aimed at decreasing the weed species population to an acceptable level through the use of a living organism. In tea fields, there are only a few

competitive plant species that can control another weed species by competing with it for one or more growth factors (water, nutrients and light). Biological control in tea could be termed more appropriately as ecological control. Control of African couch (*Digitaria abyssinica*) by planting *Brachiaria brizantha* is one such example in tea lands.

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