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HERBICIDES USAGE IN TEA

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INTRODUCTION

In tea plantations, the most vulnerable periods of weed growth are when young tea is planted and soon after pruning. In mature tea fields, the tea itself could manage the weeds by maintaining a well grown canopy.

The traditional method of weed control in tea was clean weeding by the use of scrapers which we now banned due to its detrimental effects mainly on soil erosion. The current practice is an integrated approach with cultural, manual and chemical methods (Fig.1) In young tea the most suitable weed management practice is by mulching with loppings of Guatemala or Mana grasses, and hand pulling while in mature tea chemical weed management is encouraged.

Chemical weeding is economical. It causes least disturbance to the top soil and leaves a mulch of dead weeds. When chemicals are used, it is necessary to know the properties of herbicides, adjuvant used, growth stage of weed which is more susceptible to the chemical and environmental factors.

Pre-emergent herbicides should be applied on to the soil when it is moist and before the seedlings emerge. Post-emergent herbicides (contact and translocated) should be applied after the seedlings have emerged. Weeding progammes should be selected according to the ground cover (exposure of soil surface), weed population, stages of crop growth and climatic conditions.

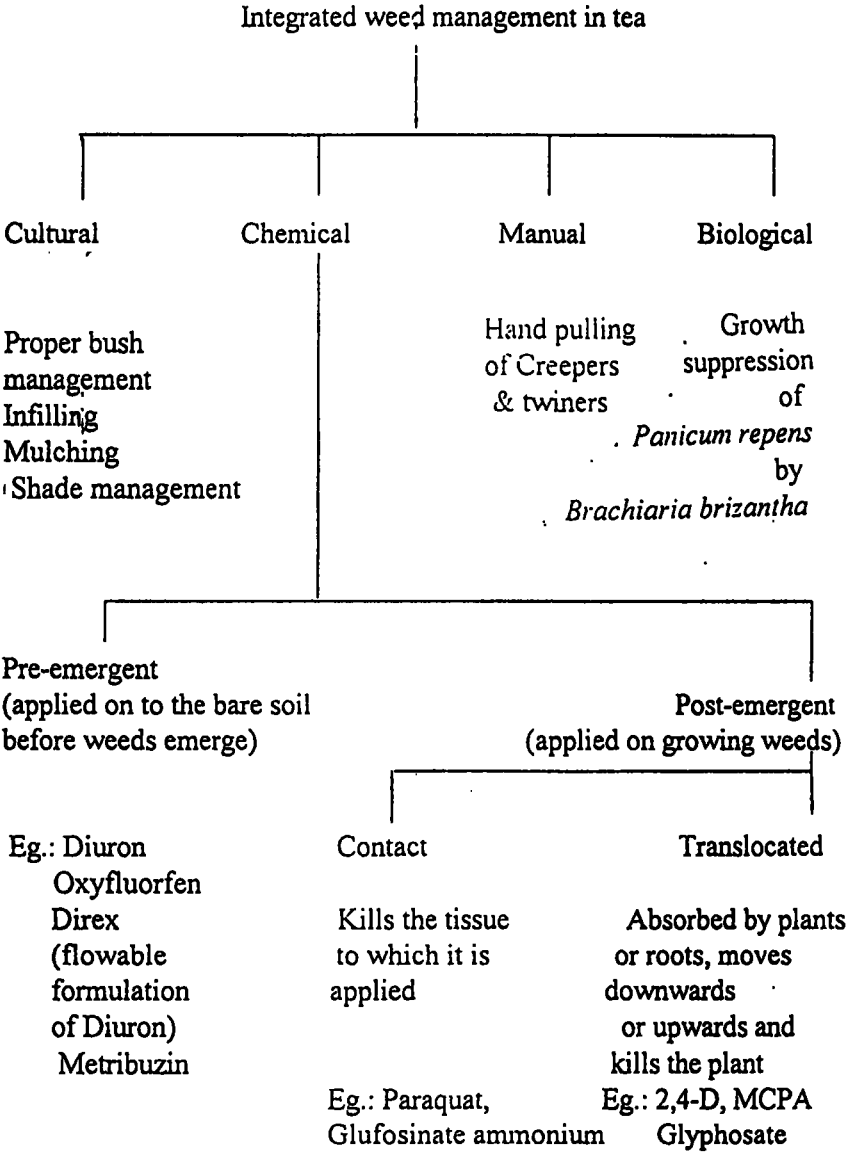

Fig.1 Components of integrated weed management in tea

The commonly used herbicides in tea plantation, their mode of action and rates of application and rates of application are as followes:

(1) **Diuron** - 3-(3,4-dichlorophenyl)-1,1- dimethylurea

Trade Names
Karmex (80% w.p)
Diuron (80% w.p)
Harcros Diuron (80% w.p)
Direx (40% a.i.- flowable formulation)

Mode of action
Photosynthesis is inhibited (effective on germinating weed seeds).

Properties
Most effective when applied before emergence of pre-seedlings, but the addition of a suitable surfactant controls young weeds.

Applied to bare, moist soil.
Absorbed by clay particles.
Acts on sprouting seeds.
Apply once in a pruning cycle.
Compatible with many other herbicides (Paraquat, Glyphosate)
No corrosive effect.
Add non-ionic wetting agent.

Rate of application
1.2 kg in 550 l of water ha^{-1} (17 ozs in 50 gal water /ac).
875 ml of Direx in 550 l of water / ha (12 f ozs in 50 gal water /ac)

Resistant weed species
Panicum repens
Crassocephalum crepidioides
Erigeron sumatrensis

2) **Oxyfluorfen** - (2-chloro-1-(3-ethoxy-4- nitrophenoxy)-4-(trifluoromethyl) benzene)

Trade Name
Goal 2E (24% a.i.)

Mode of action
Probably inhibits photosynthesis

Properties
Soil applied residual herbicide.
It could act as a pre-emergent herbicide.
Effective against mainly dicot and monocot grasses.
Compatible with most other herbicides (Paraquat, Glyphosate, 2,4-D).
Recommended for weed control in young tea and in pruned tea.
Non corrosive under normal conditions.

Rate of application
1.2 l in 550 l of water / ha (17 f ozs in 50 gal water /ac)

3) **Metribuzin** - [4-amino-6-(1,1-dimethylethyl)- 3-(methylthio) -1,2,4-triazin-5(4H)-one]

Trade Name
Sencor (70% a.i.)

* This herbicide is not yet recommended by Tea Research Institute but tested and showed promising results for managing broad leaved weeds.

Mode of action
Photosynthesis is inhibited (effective on germinating weed seeds).

Properties
Systemic herbicide in terms of upward movement.
Act as pre-emergent or early post-emergent herbicide on weeds.
Compatible with most liquid and wettable powder formulations of other pesticides.

Non corrosive.
Movement by leaching is high in clay and /or organic matter, greatest in sand.

Rate of application
1 - 1.5 kg in 550 l of water / ha

4) **Paraquat** (1,1-dimethyl-4,4-bipyridinium ion) (as dichloride salt)

Trade Names:
Gramoxone (20% a.i.)
Harcros Paraquat (24% a.i.)
Baurs Paraquat (25% a.i.)

Mode of action
Photosynthesis is inhibited (disintegration of leaf epidermal cells followed by wilting and desiccation of plant).

Properties
Non selective.
Contact, quick action.
One hour of rain free period after application of herbicide is sufficient.
Decomposes chlorophyll, activated by high temperature.
Inactivated by clay.
Use clear water.
Non-ionic and cationic surfactants are compatible.
Non corrosive (but not advisable to store undiluted Paraquat in contact with metals).

Rate of application
750 ml - 1.1 l in 550 l water ha^{-1}. (11-16 f ozs in 50 gal water /ac).

Weed spp. tolerant to Paraquat.
Paspalum conjugatum
Borreria spp
Hedyotis spp
Erigeron sumatrensis
Crassocephalum crepidioides
Panicum repens
Digiteria spp.

Commelina diffusa
Imperata cylindrica
Anredera basseloides

5) **2,4-D** (2,4- dichlorophenoxy) acetic acid

Trade Names
Fernoxone (73% a.i.)
Hedonol M (40% a.i.)

Mode of action
Abnormal growth response, affects respiration, food reserves and cell division

Properties
Translocated.
Slow in action.
Plant and root absorption.
Selective against broad leaved weeds (eg. *Poligonum* and *Commelina*).
Require rain free period of 4-6 hours after application.
Add non-ionic wetting agent with 2,4-D sodium salt.
Non corrosive.

Rate of application
2,4-D - 1.3 to 1.6 kg in 550 l water ha^{-1} (19 - 23 ozs in 50 gal water /ac)

6) **M.C.P.A.**(2, methyl -4-chlorophenoxy) acetic acid

Trade Names
Baurs MCPA (40% a.i.)
Harcros MCPA (40% a.i.)
M 60 (60% a.i.)

Mode of action
Similar to 2,4-D

Properties
Selective and broad leaved weed killer, similar to 2,4-D.
Washed off by rain if it follows soon after application (rain fast period is 4-6 hrs).
Absorption increased by wetting agents.
Readily leached from soil.

Rate of application

MCPA - 1.75 to 3.00 l in 550 l water ha^{-1} (25-43 f ozs in 50 ga l water/ac)

7)Glufosinate ammonium (Ammonium DL-homoalanin-4 YL(methyl)phosphinate)

Trade Name
Basta (15% a.i)

Mode of action
Photosynthesis is inhibited.

Properties
Non selective.
Partially systemic and contact herbicide.
Effective mainly on dicotylendonous weeds.

Rate of application
1.3 l in 550 l water / ha (18 f ozs in 50 gal water /ac)

8) Glyphosate (N-phosphonomethyl glycine)

Trade Names
Roundup (38% a.e.)
Glytox (41% a.e.)
Counter (41% a.e.)
Surpass (36% a.e.)
Destroy (36% a.e.)
Weedol (36% a.e.)

Mode of action
Inhibits protein synthesis and enzyme production

Properties
Foliar applied, systemic and non selective herbicide.
Effective on deep-rooted perennial species and also on annual and biennial species of grasses, sedges and broad leaved weeds.
Addition of kaolin improves efficiency by abrasive action of leaf cuticular surface. (Only for higher rates of Glyphosate)
Tank mixtures with residual type herbicides, such as substituted ureas, triazins, or others may reduce the activity of glyphosate.
Other combinations with foliage absorbed herbicides such as paraquat, phenoxy, or other hormone type herbicides may modify or lower action of glyphosate.
Corrosive to iron and galvanized steel.
Visible effects normally occur on annual species in 2-4 days and on perennial species in 7-10 days, after application.
Rainfast (rainless) period is 4 hours.

Rate of application
Problem weeds
Panicum repens (Couch)- 1 l in 50 l water [2% (4.4 kg a.i.)] glyphosate
Imperata cylindrica (Illuk) 1% glyphosate
Pennisetem polystachion (Foxtail) - 0.5% glyphosate
(These rates given for spot spraying and could be reduced by half by incorpo-rating 3.5 kg kaolin in 550 l of water /ha)

Other weeds - 0.2%-0.3%
glyphosate (1.2 l -1.4 l in 550 l water / ha = 17-20 f ozs in 50 gal water /ac)
Creepers- Repeat application of 0.2%-0.3% (1.2 l -1.4 l in 550 l water /ha = 17- 20 f ozs in 50 gal water /ac) glyphosate should be applied to kill the tuberous roots of creepers.

Resting of tea (no plucking) should be as follows:
If 2% glyphosate is used, rest for two weeks
If 1% glyphosate is used, rest for one week
Less than 1% glyphosate, continue plucking.

Cocktail Mixtures (recommended rates could be used as above)
Contact herbicide could be mixed with pre-emergent herbicide. Specific combinations recommended for problem weeds.

eg:

a) Paraquat + 2,4-D (for *Borreria & Hedyotis* spp. only)

b) 2,4-D + Diuron or Basta + Diuron - especially for creepers

c) Paraquat + Diuron (for grasses)

Non-ionic wetting agents
Triton AE (INDOFIL)
Teepol

Rate of application
1% solution

Wetting agent enhance spreading of spray fluids by reducing the surface tension (optimum surface tension 40-60 dyne $cm^{-2} = (40\text{-}60)*10^{-5}\ Nm^{-2}$)

Table 1

Acute toxicity - approximate oral LD rates

Herbicides	LD_{50} value (mg/kg)	Persistency in soil
Paraquat	150	Very persistent but biologically unavailable
Diuron	3400	3 months to one year or more
2,4-D (Na salt)	700	1-4 weeks

Herbicides	LD_{50} value (mg/kg)	Persistency in soil
MCPA	800	up to 1 month in moist soil & up to 6 months in dry soil
Glufosinate ammonium	2000	Non persistent
Oxyfluorfen	5000	4-9 weeks
Glyphosate	4320	Non persistent
Metribuzin	1090	1-4 weeks

Other common considerations:

1. Spray should be directed on to the weeds or ground in inter-row space only and spray drift should be avoided.
2. Use spray guards when herbicides are sprayed in young tea
3. Use only recommended dosages and ensure that dosages are calculated àccording to the active ingredients (a.i.) or acid equivalents (a.e.)
4. Avoid very hot hours and windy times for spraying herbicides.
5. Do not use muddy water; ensure that clean water is used to mix herbicides for spraying.
6. Use correct types of nozzles (Orifice size = 062)
7. Depending on weed growth use green, blue or yellow poly-jet (flood-jet) nozzles.

8. Keep the nozzle 30-45 cm above ground level.
9. Use low pressure for herbicide spraying (7000-10000 N m^{-2})
10. Use protective clothing when spraying herbicides

Acute toxicity (LD 50), and persistency of herbicides in soil are given in Table 1. Weed control programs for up country and mid country are given in figure 2.

Calendar for weed control programme (WU & WM)

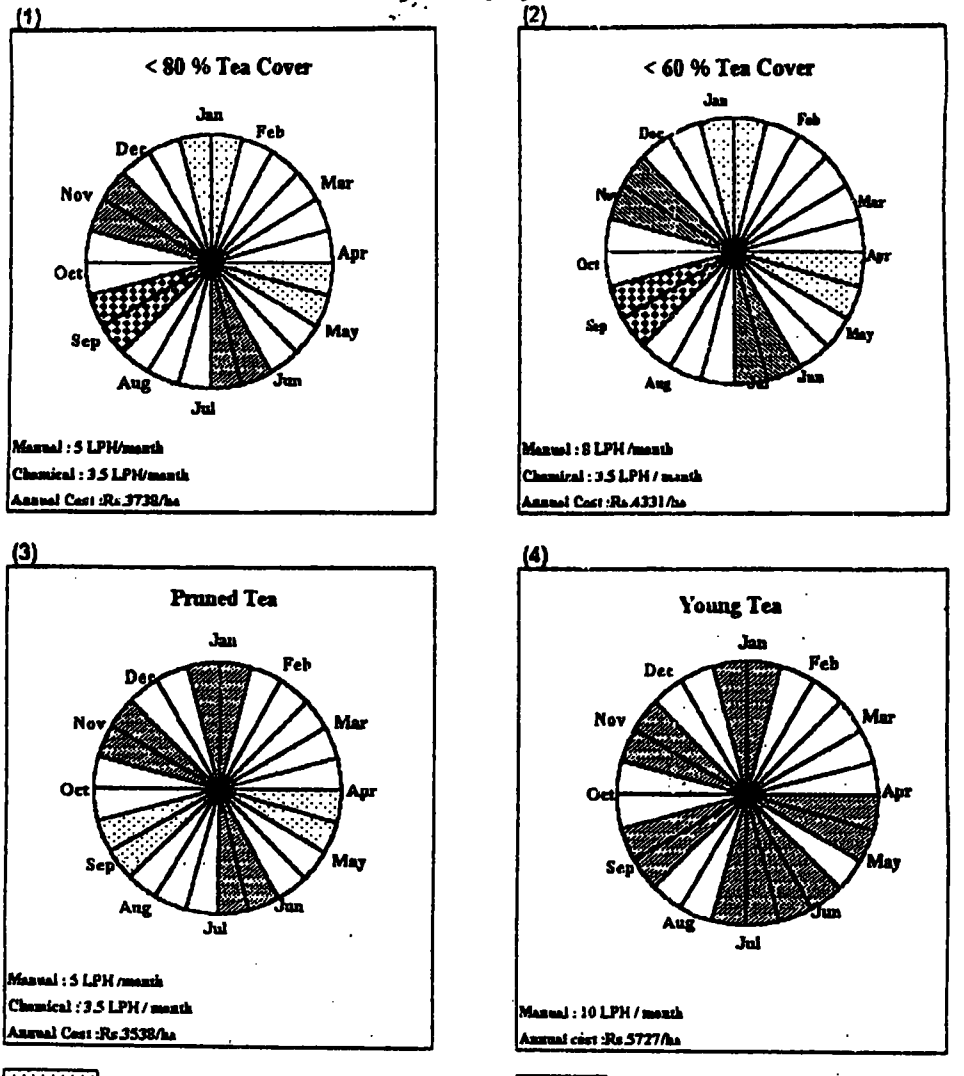

Fig. 2 - Glyphosate could be applied in April/May only for (1) & (2) categories and chemical round in January skipped Accordingly, cost will be Rs 3,366 and Rs 3,939/ha for programme (1) & (2).