

# **TEA CULTIVATION MANUAL “FOR GOOD AGRICULTURAL PRACTICES”**



**TEA RESEARCH FOUNDATION OF KENYA  
(TRFK)**

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**TRFK  
TEA CULTIVATION MANUAL FOR GOOD  
AGRICULTURAL PRACTICES**

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Tea Cultivation Manual for Good Agricultural Practices

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## FOREWORD

The Tea Research Foundation of Kenya (TRFK) and its predecessor the Tea Research Institute of East Africa (TRIEA) have been carrying out research and development activities on tea in Kenya for the last sixty years. During that period, the TRFK has developed technologies and best practices that when leveraged to the tea production system will make tea enterprises more viable, sustainable and profitable.

The good practices have been compiled into a booklet that each tea grower should have.

Good Agricultural Practices (GAP) refer to any collection of specific methods which when applied to agriculture produce results that are in harmony with the values of the proponents of those practices. This booklet presents a collection of principles for application in the on-farm production of tea that will result in safe and healthy tea products while taking into account economical, social and environmental sustainability.

The practices presented herein can be applied to a wide range of tea farming systems and at different scales. The practices are underpinned on four principles which include;

- (i) The need for economic and efficient tea production systems for enhanced production of safe products.
- (ii) Sustenance and enhancement of the natural resource base in tea environments.
- (iii) Need for a tea production system that is viable and that contributes to profitability and sustainability of livelihoods.
- (iv) Need for a tea production system that meets cultural and social demands of tea growers.

This handbook therefore presents a list of tea farming practices that can be followed at each step in the tea production process. The

practices presented herein will allow the tea grower employ a comprehensive management strategy in the tea production process.

It is expected that the wholesale adoption of the practices presented in this handbook will result in higher tea production, better quality tea products and more sustainable tea enterprises in Kenya.

## WEIGHTS MEASURES AND QUANTITIES: CONVERSIONS

### *Length*

|                |         |   |                   |
|----------------|---------|---|-------------------|
| 10 millimetres | (mm)    | = | 1 centimetre (cm) |
|                | 100 cm  | = | 1 metre (m)       |
|                | 100 m   | = | 1 hectometre (hm) |
|                | 1,000 m | = | 1 kilometre (km)  |

### *Area*

|                        |                        |   |  |
|------------------------|------------------------|---|--|
| 100 square millimetres | (mm <sup>2</sup> )     | = | 1 square centimetre (cm <sup>2</sup> ) |
|                        | 10,000 cm <sup>2</sup> | = | 1 square metre (m <sup>2</sup> )       |
|                        | 10,000 m <sup>2</sup>  | = | 1 hectare (ha)                         |

### *Volume*

|                         |                    |   |                         |
|-------------------------|--------------------|---|-------------------------|
| 1,000 cubic millimetres | (mm <sup>3</sup> ) | = | 1 millilitre (ml)       |
|                         |                    | = | 1 cubic centimetre (cc) |
|                         | 1,000 ml           | = | 1 litre (l)             |
|                         | 1,000 cc           | = | 1 litre                 |

### *Weight*

|                  |                 |   |                 |
|------------------|-----------------|---|-----------------|
| 1,000 milligrams | (mg)            | = | 1 gram (g)      |
|                  | 1,000 g         | = | 1 kilogram (kg) |
|                  | 100 kg          | = | 1 quintal (q)   |
|                  | 1,000 kg or 10q | = | 1 tonne (t)     |

### **Table B: English/metric equipment**

|               |             |             |      |               |
|---------------|-------------|-------------|------|---------------|
| <i>Length</i> | 1 inch (in) | = 2.540 cm  | 1 cm | = 0.394 in    |
|               |             | = 25.40 mm  | 1 m  | = 39.37 in    |
|               | 1 foot (ft) | = 0.305 m   |      | = 3.281 ft    |
|               |             | = 30.480 cm |      | = 1.094 yd    |
|               | 1 yard (yd) | = 0.914 m   | 1 km | = 0.621 miles |
|               |             | = 91.440 cm |      |               |
|               | 1 mile      | = 1.609 km  |      |               |

### *Area*

|               |                    |                         |                   |                         |
|---------------|--------------------|-------------------------|-------------------|-------------------------|
| 1 square inch | (in <sup>2</sup> ) | = 6.452 cm <sup>2</sup> | 1 cm <sup>2</sup> | = 0.155 in <sup>2</sup> |
| 1 square foot | (ft <sup>2</sup> ) | = 0.093 m <sup>2</sup>  | 1 m <sup>2</sup>  | = 1.196 yd <sup>2</sup> |
| 1 square yard | (yd <sup>2</sup> ) | = 0.836 m <sup>2</sup>  |                   |                         |
| 1 acre        |                    | = 0.405 ha              | 1 ha              | = 2.471 acres           |

### Volume 1

|                                 |                         |                   |                         |
|---------------------------------|-------------------------|-------------------|-------------------------|
| fluid ounce (fl oz)             | = 6.452 cm <sup>2</sup> | 1 cm <sup>2</sup> | = 0.155 in <sup>2</sup> |
| 1 pint (pt)                     | = 568.25 ml             |                   | = 1.759 pt              |
| 1 gallon (gal)                  | = 4.546 litres          |                   | = 0.220 gal             |
| 1 cubic inch (in <sup>3</sup> ) | = 16.39 cc              | 1 ml              | = 0.061 in <sup>3</sup> |
| 1 cubic foot (ft <sup>3</sup> ) | = 0.028 m <sup>3</sup>  | 1 m <sup>3</sup>  | = 35.31 ft <sup>3</sup> |
|                                 | = 28.32 litres          | 1 litre           | = 61.02 in <sup>3</sup> |

### Weight

|                       |              |                    |
|-----------------------|--------------|--------------------|
| 1 ounce (oz)          | = 28.35 1 kg | = 35.27 Oz         |
| 1 pound (lb)          | = 453.59 g   | = 2.205 lb         |
|                       | = 0.454 kg   |                    |
| 1 hundredweight (cwt) | = 50.80 kg   | 1 ton = 2,204.6 lb |
| 1 ton                 | = 1,016.0 kg | = 0.984 ton        |
|                       | = 1,016 t    |                    |

### Others

|                      |                               |                     |                            |
|----------------------|-------------------------------|---------------------|----------------------------|
| 1 oz/yd <sup>2</sup> | = 33.91 g/m <sup>2</sup>      | 1 kg/m <sup>2</sup> | = 1.843 lb/yd <sup>2</sup> |
| 1 oz/yd <sup>3</sup> | = 37.08 g/m <sup>3</sup>      | 1 kg/m <sup>3</sup> | = 1.686 lb/yd <sup>3</sup> |
| 1 oz/gal             | = 6.236 g/litre               | 1 g/litre           | = 0.160 Oz/gal             |
| 1 lb/in <sup>2</sup> | = 0.070 kg/ml                 |                     |                            |
| 1 hp                 | = 0.746 kw                    | 1 kw                | = 1.340 h.p                |
| 1 B. T. U.           | = 251.88 gram-calories (gcal) |                     |                            |

Celsius (Centigrade) to Fahrenheit is:

$$^{\circ}\text{F} = \frac{{}^{\circ}\text{C} \times 9}{5} + 32$$

Fahrenheit to Celsius is:

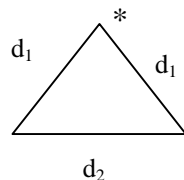
$$^{\circ}\text{C} = ({}^{\circ}\text{F} - 32) \times \frac{5}{9}$$

No. of plants per hectare

(1) Square planting:  $\frac{10,000}{d^2}$

(2) Rectangular planting  $\frac{10,000}{d^1 \times d^2}$

(3) Triangular (equilateral) planting:  $\frac{11,547}{d^2}$





In each case, "d" is the distance or one of the distances  $d_2$  between the plants in metres.

*Conversion of green leaf into made tea*

Average % out-turn of green leaf into made tea is 22.5% or 4.5 kg green leaf give 1kg made tea.

# **NURSERY PRACTICES**

## **SITE SELECTION**

- Should be near a permanent water source
- Should be well sheltered from the prevailing winds.
- Soils should be free draining and friable.
- Soil pH between 5.0 and 5.6.
- Avoid low-lying areas which become very wet during the rains or which get frost during dry months.

## **SEED NURSERIES**

### **Seed preparation**

- Propagate as soon as seed is received.
- If it has to be stored, keep in a cool, well ventilated room and allow free movement of air all round each of the containers of seed.
- Soak the seeds in water, ensuring that they do not form a thick mass of seeds floating on the surface; stir the seeds occasionally.
- Remove seeds which sink within 24 hours to the routine germinating area.
- Allow a further 48 hours to sink, for seeds still afloat; keep separate at every stage from earlier sinkers.
- Discard seeds still floating after 72 hours.
- Discard seeds which appear black and sticky or have a fungal growth.
- Place the sinkers in direct sunshine; ensure that they do not dry out by sprinkling with water when necessary.
- Plant in the nursery as soon as they crack.
- In cloudy weather, place the seeds on beds raised 15 cm above the surrounding soil and which have a 5 cm top layer of coarse river sand.
- Place the seeds on the beds in a single layer, cover with a single thickness of hessian or dry grass and keep damp by watering lightly.
- Pick the seeds daily, removing all cracked seeds to the nursery.

## **Seed planting**

- Plant seeds with their “eyes” horizontal.
- Cover by 2.5 cm of soil.
- For stumps, plant seeds at a spacing of 12.5cm triangular.
- Rake the beds very finely and then roll very lightly.
- Mark the seed sites by pressing on to the bed surface a board through which long nails have been hammered at the correct spacing so that the nails mark the soil.

## **Bed preparation**

### ***Seedling stumps***

- Dig the site over to a depth of not less than 75cm.
- Roughly level the soil and mark out the beds; the beds should be no wider than 1½ m, with a path of 45cm wide between adjacent beds.
- Align beds so that these paths can act as drains.
- Remove the soil from the paths and place on the beds until the beds are raised 15cm above the paths.
- Rake the beds to provide a soil of fine tilth.
- The nursery should be provided with light dappled shade.
- Plant seeds directly into the nursery beds.
- Allow the seedlings to grow for two to three years.
- Thin the shade out gradually so that it is completely removed three to six months before transplanting stumps.
- Remove seedlings from the nursery with bare roots and prune off their shoot systems at a height of 10cm above the level of the nursery soil

### ***Sleeved seedling plants***

- Plant one seed per sleeve, covered with 2.5cm of soil and with the “eyes” horizontal.
- Use sleeves of 250 gauge polythene, of not less than 10cm circular diameter and not less than 30cm in length.

## Seedling nursery maintenance

### *Fertiliser application*

- Direct fertilizer application in seedling nurseries is not recommended.
- If the nursery soil has a pH greater than 6.0, seek advice from the TRFK.
- In areas where soils are known to be deficient in sulphur, sulphate of ammonia (SoA) should be applied to the seedlings as follows:-
  - ◆ Apply fertilizer every four months starting as soon as the seedlings are 15cm tall.
  - ◆ Apply SoA at the rate of  $16\text{g/m}^2$  and alternate at every second application with an NPK compound fertilizer (or mixture of straight fertilizers) with nutrient ratios of 5:1:1 or more concentrated in P and K either with or without additional sulphur.
  - ◆ Apply the fertilizer at a rate to provide about  $4\text{g/m}^2$  of nitrogen (e.g.  $16\text{g/m}^2$  of 25:5:5 NPK, or  $20\text{g/m}^2$  of 20:10:10 NPK) on each occasion.
  - ◆ Alternatively, apply DAP at the rate of  $7\text{g/m}^2$ .
  - ◆ When the seedlings are small, apply fertilizers in solution form from watering cans at the rate of  $1.3\text{ litres/m}^2$ , followed immediately by an application of water to wash the fertilizer from the foliage.
  - ◆ On larger seedlings, dry fertilizer can be sprinkled over the surface of the soil, taking care to spread the fertilizer evenly and to keep it off the seedlings, stems and leaves.

### *Weed control*

- For sleeved seedlings, weed manually.
- Apply *Simazine* to nursery beds immediately after planting the seed (pre emergent).
- First try on a small scale to check that there is no adverse effect on young tea seedlings.
- OR, weed manually.

## Vegetative propagation

### (i) *Stump nurseries*

- Dig nursery beds thoroughly to a depth of at least 75 cm.
- Walls (example made of woven bamboo laths) should be constructed round the bed.
- Broadcast fertilizer over the surface of the soil and then mix thoroughly with soil to a depth of about 25cm.
- If the soil is dug elsewhere and transported to the nursery, use the rates in the table below. If the nursery is constructed on site and the soil dug to 25 cm, use  $\frac{1}{4}$  of the rates in the table below

|                 |                        |                        |
|-----------------|------------------------|------------------------|
| Forest soils    | Single super phosphate | (600g/m <sup>3</sup> ) |
|                 | Sulphate of potash     | (300g/m <sup>3</sup> ) |
| Grassland soils | Single super phosphate | (600g/m <sup>3</sup> ) |
|                 | Sulphate of potash     | (300g/m <sup>3</sup> ) |
|                 | Sulphate of ammonia    | (300g/m <sup>3</sup> ) |
| Exhausted soils | Diammonium phosphate   | (600g/m <sup>3</sup> ) |
|                 | Sulphate of potash     | (300g/m <sup>3</sup> ) |

- Level the soil carefully, cover with a 7.5-8.0 cm layer of subsoil and lightly roll.
- Plant cuttings widely in the nursery (not less than 15cm apart) then cover beds with polythene sheeting and shade as described for sleeve nurseries below.

### (ii) *Sleeve nurseries*

- Use sleeves 150 gauge polythene with a width of 10cm (4in) or diameter of lay-flat 5.25 cm (21/2 in) and 25cm (10 in) long.
- To raise larger plants (for infilling), use larger sleeves of 250 gauge polythene with circular diameter of 10 cm (4 in) i.e. 15 cm width and 35-40 cm (14-16 in) long.
- Spot-seal the sleeves or staple once in the middle of the bottom edge to allow drainage.
- Separate top soil (1ft from top) and sub-soil.
- Remove all roots and hard soil lumps or stones from the soil used to fill sleeves.

- Mix 8 wheelbarrows of sub soil/top soil mixture with  $\frac{1}{4}$  kg of DAP (for 1200 sleeves).
- Fill the sleeve to a depth of 17 – 17.5cm (bottom  $\frac{3}{4}$  of sleeve) with sub soil/top soil + fertiliser mixture.
- Top up the remaining depth of 8 – 7.5 cm ( $\frac{1}{4}$  of sleeve) with sub soil only.
- Pack the soil fairly firm; it should not be loose nor should it be packed hard and should be damp at all times.

## NURSERY CONSTRUCTION

- ***Low shade nursery:-*** 6ft wide x 14ft long x 4ft height (Per Unit – 1200 plants). Allow a ventilation of 1ft at the top
- ***High shade nursery:-*** height of not less than 5ft; width and length depend on number of beds desired. Allow 1ft between bed and the shade structure.

### Bed construction

- Dimensions: 4 ft x 12 ft (Per Unit – 1200 plants).
- To mark bed, cut pegs of 45cm; Drive 15cm into the soil (leaving 20cm of the peg above the surface) at 60 cm (2ft) intervals.
- Tie fitos on the pegs -15cm from the ground.
- Arrange hoops at 60 cm (2ft) intervals.
- Hoops should leave a space of 20 – 25 cm above the top of the sleeves.
- Arrange ridges across the beds at 120cm (4ft) intervals.
- Arrange the sleeves in the nursery bed such that 200 sleeves occupy 2ft x 4ft (**stacking**).

## SELECTION AND PREPARATION OF CUTTINGS

### (i) *Treatment of mother bushes*

- Prune mother bushes twice a year even if the cuttings are needed only once a year.
- Prune 5 to 6 months ahead of intended propagation.

- Prune by a straight normal cut-across the framework, about 2.5 cm (1 in) above the previous pruning level or at 40 cm (16 in) if bushes had not been pruned before.
- Clean out (remove weak and crossed branches) only once a year, during one of the prunes.
- New shoots are ready for cuttings between five and seven months after pruning.
- Never allow new stems to remain on the mother bush for more than seven months as the material becomes hard and the resulting cuttings grow poorly.
- Do not cover mother bushes after pruning.
- If pruning is between January and June the pruning height should be 5 cm (2 in) above the previous pruning level and when pruned between July and December, prune at 2.5 cm (1 in) below the previous level. Thus, the pruning level rises 2.5 cm (1 in) a year.
- If mother bushes have aphid infestation, thoroughly spray the upper foliage with an insecticide (Karate at 4ml/litre of water) before the prunings are taken off.
- Apply twice as much fertilizer to mother bushes as would be applied to plucked bushes of the same age (i.e. rate 300kg N/Ha/yr)
- Apply the fertilizers in at least two doses each year. If they are pruned every five to seven months, apply two or three months after each pruning.
- When few bushes are pruned per day, apply fertilizer to each bush immediately it is pruned.
- Take back branches and shoot material left over after the cuttings have been prepared, to the mother bushes as mulch.

## **(ii) *Preparation of cuttings***

- Wrap cut branches or prunings (whips) for cuttings are in wet sacking, take to a shelter near the nursery water immediately.
- Make cuttings under shade and keep shaded at every stage.
- Use only vigorous young shoots between five and seven months old when making cuttings.

- Discard the very soft tips and the very hard lower parts of the branches where bark is forming.
- Each cutting should consist of a single leaf with 3 to 4 cm of stem below the leaf
- Prepare cuttings using very sharp knives.
- If the internodes are short, so that less than 3 cm of stem will be below the lower leaves, use cuttings with extra leaves but remove the lower leaves.
- Soak cuttings, immediately they are prepared, in a container full of fungicide *mancozeb* (e.g. Dithane, Emthane) for about 30 minutes, before planting. (see label for rate of mixture).
- Never place too many cuttings in the container.
- Do not use cuttings with damaged leaves.
- Multi-leaf cuttings give more branches to the young plant and are ideal if there is plenty of material.(especially ideal for high areas with low temperatures).

### **(iii) *Planting cuttings***

- The leaf or the bud must never touch the soil (plant cuttings in the sleeves so that the bud is just above the soil level).
- Where the cuttings' leaves are naturally deflexed (bending backwards instead of upwards), the stems should be inserted into the soil at an angle so that the leaves are clear of the soil.
- During planting, fingers should not touch the top or bottom cuts of the stems as the sweat from the fingers may affect survival.
- The cuttings should be kept moist during planting by frequent watering.
- The cuttings and the soil between the sleeves and the walls (outside the sleeves in the case of high-shade nurseries) are thoroughly watered.
- Watering should be done gently as strong jets may displace cuttings.



- Stretch the clear polythene sheeting (250-500 gauge) taut over the hoops and bury 1ft deep into the soil, to exclude any exchange of air.

## **NURSERY MAINTENANCE**

- Inspect all beds at least once a week.
- The beds should be regularly checked for weed growth, insect pests and diseases and treated as necessary.
- Always weed by hand pulling.
- During dry weather keep the soil around the polythene damp.
- Water the beds 21 days after planting or when sheet is noted dry. Check for pests and diseases and treat accordingly.
- Regulate shade depending on the prevailing weather.
- Shade should allow 50% of the incoming sunlight.

### ***Hardening off***

- 3-4 months after planting (new shoots are about 20 cm (8 in) tall loosen the polythene sheeting at both ends of the bed and leaving the polythene sheeting loose on the ground.
- One week later, roll the polythene up at both ends and leave that way so that air may circulate.
- After one week roll the polythene sheeting up 30 cm (1 ft) at each end and a week later roll it up 120 cm (4 ft) at each end.
- Increase this weekly opening by 1.2 m (4 ft) per week until the whole bed is uncovered.
- Do not allow the soils in sleeve to dry up during the hardening-off period.
- Start fertilizer application after complete removal of polythene sheet as follows:-
  - ◆ Make weekly applications of NPK(S) fertilizer in solution; 1g/m<sup>2</sup> of nitrogen in 1.3 litres of water (10g NPK(S) in 10lts 1 tablespoon in 10lts watering can).
  - ◆ Follow with an immediate application of water, to wash the fertilizer solution off the leaves of the young plants.
  - ◆ When the plants are to remain in their nursery for long periods (e.g. over 12 months), then reduce frequency of

application; Apply NPK(S) solution as above for three months and then change to  $4\text{g/m}^2$  of nitrogen(4g NPK(S)) in 1.3 litres of water every month.

### **Nurseries on high pH soils**

Nurseries should be established on suitable soil pH hence it is necessary to conduct soil pH tests of the various areas on the farm until a suitable area is identified.

- To reduce the pH of a nursery soil in which plants are already growing, use aluminium sulphate at the rate of 30g per square metre to water the nursery at monthly intervals.
- If soil of high pH is to be used for a stump nursery, dig sulphur into the soil over the full depth of 75cm.
- The amount of sulphur depends on the pH as listed in table below.
- Minimum quantity is just adequate for seed nurseries but results are better if more sulphur (up to the maximum) is used.
- For vegetative propagation, the soil must be mixed with the maximum quantity of sulphur given in Table below and left for at least the minimum time before cuttings are planted.

*Treatment of high pH soil for nursery use*

| Sulphur addition, grammes per cubic metre |                                  |  |                                  |  |
|---|----------------------------------|--|----------------------------------|--|
| Minimum                                   |                                  | Maximum  |                                  |  |
| <i>Soil pH</i>                            | <i>Sulphur (g/m<sup>3</sup>)</i> | <i>Minimum time between treatment and planting (weeks)</i> | <i>Sulphur (g/m<sup>3</sup>)</i> | <i>Minimum time between treatment and planting (weeks)</i> |
| 5.0                                       | -                                | -  | -                                | -  |
| 5.1                                       | -                                | -  | 60                               | 1  |
| 5.2                                       | -                                | -  | 115                              | 2  |
| 5.3                                       | -                                | -  | 170                              | 3  |
| 5.4                                       | -                                | -  | 225                              | 4  |
| 5.5                                       | -                                | -  | 285                              | 5  |
| 5.6                                       | -                                | -  | 340                              | 6  |
| 5.7                                       | -                                | -  | 395                              | 7  |
| 5.8                                       | -                                | -  | 450                              | 8  |
| 5.9                                       | 60                               | 1  | 510                              | 9  |
| 6.0                                       | 115                              | 2  | 565                              | 10   |
| 6.1                                       | 170                              | 3  | 620                              | 11   |
| 6.2                                       | 225                              | 4  | 675                              | 12   |
| 6.3                                       | 285                              | 5  | 735                              | 13   |
| 6.4                                       | 340                              | 6  | 790                              | 14   |
| 6.5                                       | 395                              | 7  | 845                              | 15   |
| 6.6                                       | 450                              | 8  | 900                              | 16   |
| 6.7                                       | 510                              | 9  | 960                              | 17   |
| 6.8                                       | 565                              | 10   | 1,015                            | 18   |
| 6.9                                       | 620                              | 11   | 1,070                            | 19   |
| 7.0                                       | 675                              | 12   | 1,125                            | 20   |

## CONTROL OF COMMON DISEASES AND PESTS IN NUSERIES

### (a) **Brown Blight** (*Colletotrichum camelliae*)

- Very common in nurseries which remains unduly wet for along time.
- Predisposing factors are excessive watering and dense shading
- The fungus infects leaves causing yellow to brown lesions that gradually turn from brown to grey from the center outward.
- The edges of the lesions are clearly defined and marked with concentric rings.
- Lesions start on leaf margins and spread inwards.
- Many lesions may join thereby affecting the whole leaf.
- Minute black scattered dots (fructifications) appear on both of the lesions.

### (b) **Grey blight** (*pestalotia theae*)

- The fungus affects mature leaves which form brown to grey round to oval lesions marked with concentric zonation.
- Black fructifications produced in concentric rings on the upper surface of the lesions.

### **Control**

- Avoid too much shade and over watering as these are ideal conditions for disease development.
- Apply fungicide such as Dithiocarbamates or Benlate at 20g/20litres of water alternating with either copper or dithane m45.

### **Damping off** (*Pythium ssp.*)

Is a soil borne fungal disease that may occur in nursery soil especially where soil remains unduly wet for long periods.

- Fungus attacks main stem of young plants near the soil surface causing it to rot.

- Leaves may turn yellow and the plant wilts.
- Usually the plant crumbles over at the collar region.

### ***Control***

For prevention soak cuttings should be soaked in water containing fungicide *mancozeb* (e.g. Dithane, Emthane) for about 30 minutes, before planting. (see label for rate of mixture) .

If disease is noted on young plants, ***SPRAY THOROUGHLY*** with the same as above.

### **Common cutworms (*Agrotis segetum*)**

- The caterpillars are grey brownish and are up to 4.5 mm long.
- They eat bark of stems at ground level.
- This is followed by extensive callusing and swelling around the collar.

### ***Control***

Use of baiting material either bought or prepared. The recommended formula (for 1 Ha) is as follows:-

- *Chlorpyrifos* (Dursban 48% EC, Gladiator, Tricel or Cyren) – 100ml.
- Wheat bran – 50kgs.
- Sucrose (molasses or sugar) – 250g.

Mix insecticide well with bran; then add molasses or sugar and mix. Finally add water and mix thoroughly. Broadcast in the affected area.

### **Citrus aphid (*Toxoptera aurantii*)**

- Brown aphids (up to 3mm long) are found in large numbers on the youngest shoots and leaves.
- Affected leaves curl backwards.

### ***Control***

Spray with Karate 75 EC at 4ml/liter

## TEA VARIETIES AND CLONES

Major tea varieties, grown in Kenya:

1. *Camellia sinensis* var. *sinenensis* (Chinary)
2. *Camellia sinensis* var. *assamica* (Assam)
3. *Camellia sinensis* var. *assamica* sp *lasiocalyx* (*cambodiensis*)

### TRFK released clones

|                         |              |              |              |
|-------------------------|--------------|--------------|--------------|
| TRFK 11/4               | TRFK 7/3     | TRFK 303/186 | TRFK 347/573 |
| TRFK 301/5              | TRFK 56/89   | TRFK 31/11   | TRFK 31/28   |
| TRFK 303/178            | TRFK 7/14    | TRFK 303/152 | TRFK 55/56   |
| TRFK 303/1199           | TRFK 6/8     | TRFK 303/179 | TRFK 303/352 |
| TRFK 303/216            | TRFK 303/156 | TRFK 303/745 | TRFK 55/55   |
| TRFK 108/82             | TRFK 303/259 | TRFK 303/348 | TRFK 430/90  |
| TRFK 303/231            | TRFK 337/3   | TRFK 303/388 | TRFK 371/3   |
| TRFK 7/9                | TRFK 31/27   | TRFK 303/366 | TRFK 306     |
| TRFK 100/5              | TRFK 337/138 | TRFK 347/314 | TRFK 347/26  |
| TRFK 54/40              | TRFK 338/13  | TRFK 303/352 | TRFK 347/336 |
| TRFK 31/8               | TRFK 303/999 | TRFK 303/978 | TRFK 31/29   |
| <sup>2</sup> TRFK 301/4 | TRFK 303/791 | TRFK 12/19   |              |

*See TRFK Clonal catalogue for attributes released clones.*

## TEA ESTABLISHMENT

### SITE SELECTION

#### *Ecological Requirements for cultivation*

- i) Rainfall min: 1200mm.
- ii) Temperature: min 13<sup>0</sup>C, max 30<sup>0</sup>C.
- iii) Altitude: 1500- 2250 amsl.
- iv) Soil: 4.0-5.6 pH and deep well drained (minimum of 2 m i.e. 6 ft).
- v) Avoid water logged areas or rehabilitate prior to planting.
- vi) Avoid areas of *hard-pan of clay, murram, gravel or rocks* unless it is possible to loosen the hard-pan.
- vii) Do not plant *Eucalyptus* trees within 30 m of tea, as their roots compete with tea roots for available water.

#### *Tea soil indicator plants*

Shrubs: (*Triumfetta macrophylla*, *Vernonia auriculiferra*, *Pauridanta holst*)

Herbs: (*Borreria princeae*)

Ferns: (*Pteridium acquilinum* (Bracken)

Trees: (*Newtonia buchanani* and *Albizia* spp).

### SAMPLING SOILS

- Several samples should be taken from a field.
- Dig small pits in a grid pattern over each half hectare.
- Put about 50g of each of the topsoil (0 - 20 cm), middle soil (20 - 40 cm) and bottom soil (40 - 60 cm) from each pit into three bags: viz. ten sets of top soil in one bag marked “A”, ten sets of middle soil in one bag marked “B” and ten sets of bottom soil in one bag marked “C”.
- Mix the samples in each bag thoroughly.
- For top soil dig ten pits to a depth of 20 cm and take a slice of soil about 2 cm thick from each side of the pit using a garden trowel.
- 1½ kg of soil for the test is adequate.
- For subsoil sampling, an auger is advantageous. The auger should be the ordinary carpenter’s type 3 to 5 cm in diameter. The best

size is 4 cm diameter and total length to 60 cm. The twist bit of the auger is 20 cm long and is just the depth of normal topsoil.

- Cut or file marks at 20 cm and 40 cm above the top of the bit.

### ***Sampling using an auger,***

- First make the surface firm by trampling, then press the top of the bit gently in and turn the handle until the whole of the bit is in the soil.
- Pull the tool out with the soil sample safely lodged in the convolutions of the bit.
- Peel off the sample carefully into a polythene bag which contains a piece of thick paper on which is written the site number and depth letter. The “A” sample can very easily be taken with one auger dip, and is uncontaminated provided the tool is clean.
- To obtain the “B” sample, insert the auger tool in the same hole, turn the handle until the 40 cm file mark is reached, and then pull up and remove the sample in the convolutions of the twist bit as above.
- When pulling up the “B” sample some topsoil will drop into the hole. To remove this, insert the auger and drill about 5 cm, pull up and discard the soil.
- The “C” sample can be taken quite cleanly. Contamination of the “B” and “C” samples with topsoil can be reduced to a minimum if the outer part of the soil in the twist bit is scrapped lightly with a knife.
- Repeat the same for the ten holes marked previously in a grid over each half hectare.
- Secure bags closed with a strong string.
- Sample hut sites in the same way with proportionately fewer holes for the smaller ones but not less than three holes per hut site.

### ***Packing material***

- Never use bags made of cloth.
- Bags made of polythene tubular film of 250 or 300 gauge and 30 x 23 cm lay-flat diameter, heat sealed at the bottom, are ideal.



- Samples should not be air-dried before sending to the laboratory,
- Samples should be sent as soon as collected.
- Bags are used once only, and if necessary can be used in the final storage of the sample for reference purposes.
- Details should be written on labels in indelible ink or pencil.
- Labels should be tied or stapled on the outside.
- Same details should also be written on a slip of paper inside the bag.

## **LAND CLEARING AND PREPARATION**

### ***Clearing***

- Avoid gradients of 20 per cent or more; gradual slopes are preferred to keep erosion to a minimum.
- Flat areas should be able to be adequately drained to avoid water-logging.

### **Long grass**

- Clear mechanically by a gyramor flail attached to a suitable tractor or by hand, using pangas (machetes) and jembes (hoes).

### **Short grasses**

- Clear by ploughing and harrowing.

### **Light vegetation**

- Use the modern type rotovator mounted on a suitable tractor which can be put to work without any prior clearing of vegetation (Three rounds of rotovating are adequate).

### **Forest land**

- Ring-bark or frill trees to kill them (not less than 18 months) before clearing.
- Fell trees after they die and remove the roots as completely as possible.
- Never dump timber and trash from a clearing on to land that will be needed for planting with tea in future.

- Clear away from the site all pieces of “couch” grass and free roots which become exposed.
- Follow with at least two ripping operations, the second ripping being across the first.
- Hand fork after each operation to reduce the risk of losses from *Armillaria* disease in the tea in future years.
- The final ripping before planting must always be across the gradient.
- Plough and harrow at least twice to break down the clods of soil from around the grass roots.
- Subsoil when necessary. This should precede lining out, or if contour planting is envisaged, both can be combined.
- If both are combined, place the sub soiling tines at the required spacing, staking will follow behind the tractor by placing marking stakes at the required planting distances.
- If sub soiling is not considered necessary or possible, lining is carried out as a separate operation.

### ***Tea following wattle***

- After felling, wattle stumps become infested by parasitic fungi which cause brown root rot and charcoal stump rot diseases of tea.
- Leave trees and stumps in the ground for a minimum of three years before planting tea.
- This time interval can be reduced if the wattle trees are frilled before felling although this practice destroys wattle bark.
- In smallholding areas, farmers can plant row crops such as beans and potatoes during the three-year period.

### ***Removing dead shade trees***

- Ring bark or frill the trees and leave for at least 18 months before felling.
- Fell by sawing or chopping through the trunk as close to the ground as possible; saw off the branches before felling to minimize damage to the tea bushes.

- Cut the branches and trunk into sections and haul out through the tea.
- Cover the exposed surface of the trunk with soil to a depth of 10cm
- There is no need to remove the complete root system of the trees if they have been successfully and completely killed.

### ***Terracing***

- Fill the holes from uprooted tree stumps.
- Cut-off or down drains should be sited where there is hollow or depression in the area for planting.
- Measure other cut-off drains from this; no graded terrace should have water flowing in one direction for more than 300m. Shorter distances are better as an insurance against heavy storms.
- If a road is to run across the top of, or through the area, culverts must be placed so that they discharge water into a cut-off drain.
- Choose an “O” or starting line and mark points at the correct distances along this from which terraces will run laterally.
- An “O” line is necessary between each two down drains, or between a drain and a road where it is decided to spill terrace water on to a road and this road is more than 300m from a drain.
- A road tracer is accurate enough to mark out graded terraces, but if neither this nor a surveyor’s level is available, a small spirit level which will fit on to a cord may be used.
- Each graded terrace is marked out from the “O” line to the nearest drain or to a road if the roadside drain is to take water from the terraces.
- Where a terrace crosses depression and there is no run-off drain there, it is necessary to take short shots and so follow the contour accurately.
- When a spirit-level is used, shots of 7m are most suitable.
- Fix the string to the top of two 1-metre high thin stakes, one being “V” notched 3cm into the top to give the required fall.
- Place the spirit level midway between the stakes.

- After marking out is completed, the tractor and terracer should start on the first terrace from the top of the field.
- Terraces can also be done by hand.
- Terrace trough should be at least ½ m deep and 2 m wide.
- On steeper slopes of more than 20 percent, the vertical interval can be maintained at 2 m and terrace banks made narrower
- Make out banks by hand as they are well consolidated; plant a cover crop of oats or love-grass immediately.
- Where the slope is steeper than 20 percent, the fall of the terraces from the “O” line should be increased from ½ percent to 1½ percent.

### **Weed control**

- Do not apply persistent herbicides to the cleared land prior to planting.
- If the land is not to be planted with tea for at least three months, then persistent herbicide should be applied at doses of up to 7 kg active ingredient of each chemical per hectare (e.g. Karmex - 8.75 kg).
- Remove couch and other grasses with Round-up® (Glyphosate) at 6 litres per hectare.
- Plant tea not earlier than six weeks after such treatment.
- Kill off all vegetation by applications of Basta at 2 litres per hectare. Repeat applications to discourage deep-rooted plants e.g. Kikuyu grass. Doses up to 3 litres/ Ha can be used.
- Cover crops such as Oats and Guatemala grass are recommended.
- When a delay between clearing and planting is inevitable, plant the land to oats (*Avena sativa*)-(variety suregrain) or Guatemala grass (*Tripsacum laxum*).
- Broadcasting of cover crop seed:- disperse seeds and superphosphate evenly over the whole area and then mix into the top 5 cm of soil.

## **Windbreaks**

Windbreaks reduce the speed of wind thereby decreasing loss of moisture loss from soil by evaporation and from the plants by evapotranspiration.

- Windbreaks should be formed by a belt of growing trees which are taller than the tea.
- Establish a series of windbreaks across the direction of the prevailing and most damaging wind.
- Site windbreaks so that they interrupt the wind across exposed hills and across narrowing valleys.
- Determine the direction of the wind as accurately as possible, bearing in mind that the direction alters over small distances as a result of topographical features.
- The effective height of trees should be 10m tall and the belts of trees should be 85 m apart.
- On sloping ground, the distance between adjacent belts should be less. If the belts become too close, tea yields will be reduced by shading and by competition with the shelter trees.
- Site windbreaks at right angles to the wind, especially on windward slopes, over the top of the hills and across the valleys.
- Because of local changes in wind direction, these belts will not form straight lines except on flat or uniformly sloping ground.
- There should be no gaps in the belts through which the wind can accelerate causing even more damage to the tea.
- The belts of trees should extend at least 20 m beyond the limits of the area which is to be protected.

### ***Trees recommended for windbreaks***

*Hakea saligna* (75m x 2m), *Tea* (75m x .72m), *Grevillea robusta* (75m x 2m).

## PLANTING

### *Size of new plants at transplanting time*

- Plants with one shoot 20 cm (18 in) tall, or 15 cm (6 in) if decentred, or with two or more shoots 15 cm tall and with roots which have reached the bottom of sleeves (25 cm or 10 in long).
- Plants which reach 30 cm (1 ft) tall in the nursery should be cut-across (decentring) at 15 cm.
- For in-filling, plants should remain in the nursery for about 18 months and be pruned at 15 cm (6 in) when they reach a height of 30 cm (1 ft) and again at 20 cm (8 in) when they reach a height of 35 cm (14 in).
  - ◆ This pruning will encourage low branching. If at transplanting infills have long soft shoots, they should be transplanted during dull weather or be shaded lightly.

### *Recommended Plant spacing and population*

#### **Triangular, Rectangular and Contour planting**

| <b>Spacing (ft)</b> | <b>No. of plants<br/>per acre</b> | <b>Spacing (cm)</b> | <b>No. of plants<br/>per hectare</b> |
|---------------------|-----------------------------------|---------------------|--------------------------------------|
| 4 x 2               | 5,624                             | 121.9 x 61.0        | 13,896                               |
| 3 x 3               | 5,589                             | 91.4 x 91.4         | 13,810                               |
| 3¼ x 3¼             | 4,762                             | 100.0 x 100.0       | 11,767                               |
| 4 x 2½              | 4,586                             | 121.9 x 76.2        | 11,331                               |
| 3½ x 3½             | 4,106                             | 106.7 x 106.7       | 10,146                               |
| 4 x 3               | 3,916                             | 121.9 x 91.4        | 9,676                                |
| 4 x 4               | 3,144                             | 121.9 x 121.9       | 7,768                                |
| 4½ x 4½             | 2,484                             | 137.2 x 137.3       | 6,139                                |
| 5 x 5               | 2,012                             | 152.4 x 152.4       | 4,972                                |
| 6 x 6               | 1,397                             | 182.9 x 182.9       | 3,453                                |

## Double hedgerow planting

| Spacing     | No. of plants per acre | Spacing (cm)        | No. of plants per hectare |
|-------------|------------------------|---------------------|---------------------------|
| 4 x 2 x 2   | 7,345                  | 121.9 x 61 X 61     | 18,150                    |
| 4 x 2 x 2½  | 6,780                  | 121.9 x 61 x 76.2   | 16,754                    |
| 4 x 2½ x 2½ | 6,027                  | 121.9 x 76.2 x 76.2 | 14,892                    |

## Field planting

- Line out and stake out prior to the rains. Leave holing be left until immediately before planting i.e. after the first rain has fallen
- Avoid Leaving holes open for several days as either the soil dries out in dry weather or puddles in wet weather.
- In very heavy clay soils, this exposure can however be an advantage, causing the smoothed sides of the holes to crumble enabling the plant roots to easily penetrate.
- In areas where the rains follow a hot dry season, the period between holing and planting should be as short as possible to avoid filling in of the holes which inevitably leads to bad planting.
- Avoid planting in excessively wet weather to prevent soil from puddling around new plants.
- The ideal planting time is when the soil is damp, rather than wet, and the weather is cloudy.
- Commence planting at the onset of the rains as soon as the soil is found to be damp to a depth of at least one metre.
- Dig planting holes beside the lining stakes.
- Holes should all have the same diameter so that the centres of the holes, where the tea plants will be, are at an even spacing.
- Excavated soil should form a single heap beside the hole.

## **Planting sleeved rooted cuttings, or clonal plants, and seedlings**

### ***Removing from the nursery***

- Sleeved plants are ready for transplanting when the roots have reached the bottom of the sleeves and also have at least 20 cm (8 in.) of top-growth.
- The cylinder of soil in sleeves should not be dry at transplanting.
- Avoid cracking the cylinder of soil and perhaps breaking the roots.
- Protect sleeves from direct sunshine at all times until planting is completed, to prevent damage to the roots.

### ***Holing***

- For standard 25 cm long x 6.25 cm diameter sleeves the holes will be 40 cm x 25 cm.
- To reduce damage of young plants by chafer grubs, holes may be sprayed with Dursban (Gladiator)

### ***Planting***

- Mix soil from each hole with 30g of single superphosphate or 15g of DAP/double superphosphate/triple superphosphate.
- In larger holes, apply single superphosphate (SSP) in proportion to the volume of the hole (see below).
- Place a 20 cm depth of soil/fertilizer mixture in the hole and slice the polythene tube with a sharp knife at the side and at the bottom, taking care not to cut any roots but retaining the sleeve around the cylinder of soil.
- Place the plant in the centre of the hole and add more soil round it.
- Gradually remove the polythene and complete filling of the hole.
- Firm down the soil with hands until the top of the plant's cylinder of soil is covered by 1-2 cm of field soil (Failure to give this covering may result in an exposed soil cylinder drying out rapidly in dry or sunny weather).



## **Hole size and amount of SSP to be applied**

| <b>Size of planting hole<br/>(dept x width)</b> | <b>Amount of SSP per hole</b> |
|---|-------------------------------|
| 45cm x 22.5cm                                   | 30g                           |
| 50cm x 25cm                                     | 40g                           |
| 60cm x 30cm                                     | 54g                           |

### ***Shading***

- No shading is needed if the plants have been adequately hardened off in the nursery.
- If plants are not well hardened off at transplanting, the plants in the field should be given the same density of shade as they had in the nursery at the time of removal.
- Shade should be of a kind which will soon break down, such as bracken fronds stuck into the soil.

### ***Planting sleeved seedlings***

- Only the most vigorous seedlings should be transplanted.
- 75 per cent of the most vigorous seedlings should be transplanted.
- The rest of the weak seedlings should be discarded.
- Seedlings should not be raised in sleeves.

### ***Planting seedling stumps***

- Tea seedlings are ready for transplanting as stumps when they are 1 cm thick at the collar.
- Remove seedlings by pulling them from the soil by a vertical pull.
- Pull the seedlings first and then pruned 10 cm above the nursery soil level.
- In poorly prepared nurseries, direct pulling causes many of the roots to break. In such cases the seedlings should be pruned at 10 cm above the soil level before they are dug out.
- Uprooting is easier if done after the onset of the rains when the soil in the nursery has been wetted to a depth of not less than one meter.

- Cut the roots of the seedlings to a length of 45 cm.
- Some nurseries produce only wide-spreading root systems, often because of shallow digging during nursery preparation or because of inadequate watering during dry weather. The roots of such seedlings should not be cut back drastically; otherwise much of the root food reserves will be removed.
- Store the prepared stumps in a cool building after being washed free of soil and wrapped in polythene in bundles of 20.
- Avoid mud baths storage, except for periods of a few hours (up to a day).
- In wet cool weather, stumps can also be covered with prunings and stored in nursery beds for a day or two.
- Never expose stumps to strong sunshine or allow drying out.
- Planting holes should be 15 cm deeper than the depth of the roots
- For seedling stumps with 45 cm of roots, dig holes to a depth of 60 cm and a width of 20 to 30 cm; the first 20 cm of the holes are excavated by a jembe (hoe) or fork jembe and the rest by another gang or the same gang using pangas or coffee diggers.
- Do not use steel spikes (*Alavangas*) except in newly loosened deep soils, as they tend to form smooth-sided holes which restrict root growth and may enclose pockets of air or water.
- In clayey soils, the sides of the holes should be roughened with a fork or allowed to crumble by action of the weather.
- Mix 60g of single superphosphate (or 30g of double or triple superphosphate) with the excavated soil.
- stumps should be kept shaded or wrapped in sacking in bundles of 50 until they are actually placed in planting holes
- Hold the stump in the centre so that the top pruning cut is 7 cm above the field level and replace the excavated soil firmly around the stump in the hole.
- The soil around the stump should be slightly higher than the field soil to allow for settling,
- Never plant a stump at the side of the hole as this restricts root development.

## Cover crops

- Sow oats between the lines of tea as soon as possible after the tea as been planted if tea planting follows immediately after land clearing and terracing.
  - ◆ Spread the oats and superphosphate (1.5 kg oats and 3 kg single superphosphate) in a shallow scrape, 30 cm wide made with a jembe between the lines of tea. Cover the seeds with the soil scraped from the sides by the cheel hoe (jembe) and firm down by foot.
  - ◆ Cut the oats back to a height of 8 cm whenever the first signs of flowering are seen.
  - ◆ Allow the stubble and the roots to remain to reduce soil erosion.
- The following can also be used as cover crops:-
  - ◆ Food crops:- beans or Irish potatoes.
  - ◆ Perennial leguminous plants:- *Crotalaria anagyroides* and some varieties of Lupin.

## Erosion control

- Practice tea bush management which encourages the early spread of the canopy, such as pegging to reduce erosion.
- Tea clones which spread easily and quickly following planting should be preferred to those which spread slowly.
- Closer spacing at planting can also produce early closure of canopy.

## Mulch

- When applying mulch, take care not to introduce weeds in tea gardens.

## Recommended materials for mulching

- Prunings and leaf fall of tea.
- Guatemala grass (*Tripsacum laxum*).
- Napier grass (*Pennisetum purpureum*) - should be cut and thoroughly wilted before spreading.

- Weeping grass (*Eragrostis curvula*) - is more resistant to decomposition which is an advantage.
- Oats (*Avena sativa*).
- Maize stalks (*Zea mays*, L.)
  - ◆ Mulch depth of five centimetres is appropriate.
  - ◆ Mulch from mature tea prunings and leaf litter, if conserved properly, will confer benefits for several years, depending on the condition of the tea at the time of pruning.
  - ◆ Never disturb soil after application of the mulch.
  - ◆ Weed control must be effected by chemicals or by hand pulling.
  - ◆ Mulch should be applied before the onset of the dry spell i.e. in November/December.
  - ◆ Continuous mulching should be avoided as it induces shallow rooting.
  - ◆ Dry mulching material applied to newly planted tea should never be allowed to touch the young tea plants.

#### *Mulching with cover crops*

- Cut down all cover crops at the onset of an extended period of dry weather (If left standing, they will rapidly remove water from the soil)
- Spread the mulch over the soil to help reduce evaporation of water from the soil.
- In areas where strong winds occur during the dry weather allow a light stand of the cover crop to remain during the dry weather to reduce the effect of this wind on the young tea plants.
- The cover crop cuttings and the application of nitrogenous fertilizer should coincide as nearly as possible.
- If the cutting is done when no nitrogenous fertilizer has been applied, make a special broadcast application of nitrogen at the rate of 10 kg per hectare.

## INFILLING

- Complete infilling as quickly as possible after planting or pruning.
- Infilling hole should be at least 60cm diameter by 60cm deep.
- Use 115g DAP and 115g sulphate of potash (SOP) in the planting hole.
- Use vigorous clonal plants for infilling to enable them to compete with the surrounding bushes.
- Vacancy as a result of attack by *Armillaria* - the plant should be uprooted immediately and moved away from the field for burning before infilling.
  - ◆ Make a new planting hole 1 m in diameter (where spacing allows) and 60 cm deep.
  - ◆ Carefully remove all pieces of the diseased plant's roots found while taking care not to damage the roots of adjacent bushes.
  - ◆ Larger pieces of old root remaining in the ground from forest trees exposed during the excavation should carefully be removed down to a depth of 100 cm and burned.

### Treatment of infills after planting

#### ***1. Planted field has vacancy within two years of planting.***

- When the original plants are being pegged or being brought into bearing by pruning, treat the infills in exactly the same way as the older plants.
- When the original plants are being pruned, prune the infills at 30 cm when the main stem at that height is 1.0 cm thick and tip-in with the older plants at 50 cm.

#### ***2. Infilling fields which are two or more years old,***

- Cut back the sides of plants adjacent to the vacant plant site. Prune the infill at 20 cm when 1.0 cm thick at that height and tip-in at the existing level of the older plants.

- In areas containing several adjacent vacancies, plant three infills for every two vacancies. After planting, keep the sides of any adjacent bushes cut back.
- In young fields, give a 40 cm prune and tip-in at the same level as the surrounding tea bushes.
- In mature tea, put long stakes next to infills to protect from trampling by pluckers or weeders.
- Three months after planting, NPKS 25:5:5:5 should be given to each plant at the rate of 50g per plant; and thereafter as applied to the rest of the field.

## **BRINGING TEA INTO BEARING**

### **CLONAL SLEEVED PLANTS**

#### **Pruning**

- Decentre the plant at six inches (6") when the plants are 12" but only when there are at least three leaves below 6".
- Prune all the shoots at 11" when they are pencil thick.
- Prune all the shoots at 16" when they are pencil thick.
- Tip in for three rounds at 20".

#### **Tipping**

- Decentre at 6" when plants are 12" (30cm).
- Tip for two rounds each at 8" (20cm), 12" (30cm) and 16" (40cm).
- Tip in at 20" (50cm) for at least 5 (five) rounds.

#### **Pegging**

- Decentre at 6" (15cm) when the plants are 12" (30cm) tall.
- Peg the shoots when they reach a height of not less than 50cm and not more than 65cm when the bark at the base of each shoot has turned reddish brown.
- Tip in to farm table at 18" (45cm) for five rounds by removing 3 leaves and a bud as soon as they develop above this height.

### **STUMP-PLANTS**

#### **Pruning**

- Stump-plants are given the first prune at 10 cm from the ground level or collar, when plants are removed from the nursery.
- Prune all the shoots at a height of 20 cm from ground level when most of these shoots are 1 cm thick at that height.
- Prune all the shoots at a height of 40 cm when most of these shoots are 1 cm thick at that height.
- Tip-in for three rounds at a height of 50 cm.

- For plants with only one or two shoots, cut-across at 15 cm when these shoots are at least 1 cm thick at this height. Prune at 28 cm and again at 40 cm when most of the shoots are 1 cm thick at these heights. Tip-in at 50 cm.

### **Pegging**

- Clear all weeds from the ground before pegging starts.
- Prepare wooden pegs 40-50 cm long from suitable material. Wire pegs can be used
- Peg the shoots when they reach a height of not less than 45 cm and not more than 60 cm, and when the bark near the base of each shoot has turned reddish-brown.
- For shoots which are too short for pegging on the first round, peg when they have reached a height of 60 cm together with other shorter shoots.
- Use one peg per shoot and arrange the shoots so that they are evenly spaced round the stump.
- Do not peg fewer than three branches. Where planting is rectangular, do not peg shoots between plants within a row but peg into space between rows
- The peg should be closer to the centre of the plant than the branch tip.
- Pegged branch should slope upwards along its whole length.
- Remove two terminal leaves and bud from each pegged shoot.
- Tip-in to form a table at 45 cm for at least five rounds by removing shoots as soon as they have developed three leaves and a bud above that height.
- Prune plants with one or two shoots at a height of 15 cm when the shoots are at least 1 cm thick at this height. Peg new shoots which develop after this prune, as above when they reach a height of 50 cm to 65 cm. Tip-in at a height of 50cm, OR peg the one or two shoots when ready for pegging. Peg new shoots arising near the bases of these shoots when 60 cm to 65 cm long.



- At the end of the first pruning cycle, three or four years after tipping-in, prune pegged bushes at a height of 40 cm, i.e. 5 cm below original tipping level.

### **Tipping**

- Decentre at 6" when plants are 12".
- Tip for two rounds each at 8", 12" and 16".
- Tip in at 20" for at least 5 (five) rounds

## **FIELD MANAGEMENT**

### **PLUCKING**

The main object of this operation is to provide the factory with leaf that is suitable for processing.

There are two groups used in describing plucking standards:-

1. *Fine Plucking* - Removal of one or two leaves and the bud.
2. *Coarse Plucking* – Removal of three or more leaves and the bud.

The second pair relates to the amount of new foliage left above plucking table.

1. *Light Plucking* – New leaves are left above the previous plucking level.
2. *Hard Plucking* – Shoots are plucked right down to the previous plucking level, so that maintenance foliage can hardly develop.

### **Four Basic types of Plucking are: -**

1. Fine and light plucking.
  2. Fine and hard plucking.
  3. Coarse and light plucking.
  4. Coarse and hard plucking.
- Coarse plucking standard produces inferior quality tea.
  - A plucking standard of two leaves and a bud compromises both quality and yields.

- Plucking by shears or motorised machines may lead to lowering of black tea quality. This may additionally affect the tea bush health in the long run.
  - Hand plucking leads to better tea quality and healthier bushes.
- (NB: The finer the plucking the better the quality of made tea.)*

## **PRUNING**

### ***Objective***

1. To reduce the height of the bush to a level manageable for plucking.
2. To remove dead/dormant twigs, which reduce productivity.
3. To rejuvenate the bush since younger shoots have more vigour.
4. To remove diseased branches /stems to stop the spread of infections.

### **Types of Pruning**

- (a) Normal (cut-across)/clean pruning- whole bush is cut-off at a pre-determined height.
- (b) Lung Pruning – a number of branches (twelve are recommended) are left unpruned on one side of the bush. Example savani, random and rim-lung pruning.

After 5 years from transplanting, tea bushes are considered mature and should receive 1<sup>st</sup> initial prune at 18”.

- In subsequent pruning, the height should be raised by 2” in every pruning cycle, which comes after 3-4 years.
- After a number of pruning cycles, the maximum pruning height is attained that is 28” (70cm) whereby a grower will be compelled to carry out, a height reduction pruning at 18” and start off a new pruning series.
- Bushes pruned during sunny weather should be covered immediately with the prunings.
- Pruning should be parallel to the slope of the ground.
- Each individual cut on the branch/stem should slope slightly to allow runoff of rainwater preventing dieback and rotting.

- Use only the pruning knife to carry-out this operation. Pruning machine can also be used.
- Prune when there is still adequate moisture in the soil.
- Prune at the beginning of the dry season (i.e. July/August: East of the rift; Dec/Jan: West of the Rift).
- **Do not** prune at the end of the dry season.

### **Skiffing**

This is a very light pruning operation whereby the bushes are cut across within the maintenance foliage layer using a pruning knife. Skiffing is done when:

- The bushes have developed a domed surface due to poor plucking.
- Heavy insect infestation necessitates opening of the bush to allow light or spray penetration as a method of control.
- Heavy pest infestation has defoliated the bush and shoots have suffered die back. Skiffing in this instance will result faster recovery than pruning.
- There is severe hail or frost damage. Skiffing will hasten recovery and prevent branch die backs.

### **Tipping-in**

- Should start before the shoots go banjhi at a height of about 25 cm to 30 cm above the pruning level.
- Is best done at 10cm (4”) above the pruning height.
- When shoots have formed three leaves and a bud above the tipping-in level they are plucked off at that level.
- Tipping-in is done for three successive rounds at the same level.
- Tip-in for five rounds on pegged bushes before normal plucking is commenced.
- Aids to tipping-in, must always be used to carry-out this operation.
- Never tip-in with a knife.

## FERTILIZERS AND MANURES

### FERTILIZERS FOR YOUNG TEA

#### *General*

- Keep field clear of weeds.
- Other crops grown in the tea should be provided with fertilizer separately at their recommended rates.
- Any convenient nitrogenous fertilizer should be applied broadcast to the soil surface, so as to provide nitrogen (N) at the rate of 12kg/ha, immediately before mulch is first applied to a field ( to compensate for the temporary loss of nitrogen from the soil while the mulch breaks down).

#### *1<sup>st</sup> year application*

##### *Stump plants*

- The first application should be 8g NPK(S) (2g of nitrogen) at about six months after transplanting.
- Repeat about every eight-weeks (two months).

##### *Sleeved plants*

- Fertilizer application should start six weeks after transplanting.
- Give small but frequent applications of 1.5g nitrogen (6g NPK(S) – 1 soda bottle top per plant) per plant starting at six weeks after planting.
- Repeat at about eight-week (two month) intervals.
- **Do not** apply during periods of drought. Spread the fertilizer round each plant in a broad ring, never less than 10cm wide.
- Do not allow the fertilizer to touch the plant's stem, and the ring should therefore be extended from 5cm from the plant stem to just beyond the spread of the shoots.
- Dibbled fertilizer into the soil to a depth of 5cm. If necessary, move back any mulch so that the fertilizer can be applied, and replace it afterwards.

## **2<sup>nd</sup> year application**

- Both stumps and sleeved plants should be fertilized in the same way;
- The application should be done in four doses (every 3 months). Each application is as per the rates shown below.

| <b>Spacing</b> | <b>Kgs/Ha</b>    | <b>Kgs/Acre</b>    | <b>Grams/Plant</b> |
|----------------|------------------|--------------------|--------------------|
| 4''X 2''       | 160<br>(~ 3bags) | 65<br>(~ 1.3 bags) | 12                 |
| 4''x 2.5''     | 160<br>(~ 3bags) | 65<br>(~ 1.3 bags) | 15                 |
| 5''x 2.5''     | 160<br>(~ 3bags) | 65<br>(~ 1.3 bags) | 19                 |

***Do not apply the fertilizer during periods of drought, and do not have less than eight weeks between two successive applications.***

## **3<sup>rd</sup> Year Application**

- The application is given in a single dose by broadcasting in the inter-row spaces as per the following rates:

| <b>Spacing</b> | <b>Kgs/Ha</b>     | <b>Kgs/Acre</b>  | <b>Grams/Plant</b> |
|----------------|-------------------|------------------|--------------------|
| 4''X 2''       | 720<br>(~ 14bags) | 292<br>(~ 6bags) | 54                 |
| 4''X 2.5''     | 720<br>(~ 14bags) | 292<br>(~ 6bags) | 67                 |
| 5''X 2.5''     | 720<br>(~ 14bags) | 292<br>(~ 6bags) | 84                 |

## **4<sup>th</sup> year application**

- The application is given in a single dose by broadcasting evenly over the surface in the inter-row spaces as per the rates below.

| <b>Spacing</b> | <b>Kgs/Ha</b>      | <b>Kgs/Acre</b>  | <b>Grams/Plant</b> |
|----------------|--------------------|------------------|--------------------|
| 4''X 2''       | 920<br>( ~ 18bags) | 373<br>(~ 8bags) | 68                 |
| 4''X 2.5''     | 920<br>( ~ 18bags) | 373<br>(~ 8bags) | 86                 |
| 5''X 2.5''     | 920<br>( ~ 18bags) | 373<br>(~ 8bags) | 107                |

In the fourth and fifth years, areas which have a single rainy season, the fertilizer can be given in a single application, preferably at the start of the rains. In areas with two distinct rainy seasons, it is preferable to give two half-applications, one at the start of each rain season.

***Do not apply Fertilizer during periods of very heavy rainfall, as some of the nutrients will be lost by surface run-off. Broadcast the fertilizer over the soil surface, avoiding the area immediately around the plant's stems.***

## **FERTILIZERS FOR MATURE TEA**

For mature tea, compound fertilizer with or without sulphur in the ratio 25:5:5:5 (N.P.K.S) is recommended. This formula may be achieved by:

- i) The use of a compound fertilizer
  - ii) Mixtures of straight fertilizers
  - iii) Alternating compounds with straight fertilizers either within an annual programme, or on a cycle basis; e.g. 20:10:10 may be used to supply half the nitrogen requirement, with sulphate of ammonia to supply the balance.
- Broadcast fertilizer evenly over the soil surface in the inter-row spaces at the rate of 150-200kg N/Ha/yr (low rate for low yielding seedling/clonal and the high rates for high yielding seedling/clonal plants)
  - **Never** apply fertiliser out during dry spells.
  - **Never** apply fertiliser immediately after pruning.
  - Apply fertilizer not less than four months before pruning if severe nutrient deficiency is detected before pruning.
  - If the vigour of the bush is very poor, delay pruning until there is improved growth.
  - UNPRUNED FIELDS – Apply at or after tipping in as long as there are rain showers or soils are wet.
  - UPRUNED FIELDS – Apply at any time during the rains (**BUT NOT DURING HEAVY RAINS**) or when there is adequate moisture in the soil.

- Amount of application depends on the spacing and the fertilizer formulation to be used(see table below).

***NOTE: NPK 25:5:5 contains 25% nitrogen. Therefore 4g of NPKS 25:5:5:5 contains 1g of nitrogen.***

### Amounts in Grams of Fertilizer to be Applied per Plant at different Spacings

| SPACING<br>“ft” | POPULATION |             | Bushes/b<br>ag NPK | Bushes/k<br>g NPK | gm<br>NPK/<br>bush | Bushes/b<br>ag NPK | Bushes/k<br>g NPK | gm<br>NPK/<br>bush |
|-----------------|------------|-------------|--------------------|-------------------|--------------------|--------------------|-------------------|--------------------|
|                 | Plants/Ha  | Plants/acre | 25:5:5             | 25:5:5            | 25:5:5             | 26:5:5             | 26:5:5            | 26:5:5             |
| 4X2             | 13448      | 5445        | 1120               | 22                | 45                 | 1169               | 23                | 43                 |
| 3 ½ X2 ½        | 12299      | 4978        | 1024               | 21                | 49                 | 1069               | 21                | 47                 |
| 3x3             | 11970      | 4840        | 997                | 20                | 50                 | 1041               | 21                | 48                 |
| 4X2 ½           | 10766      | 4356        | 897                | 18                | 55                 | 936                | 19                | 53                 |
| 3 ¼ X3 ¼        | 10000      | 4047        | 833                | 17                | 60                 | 870                | 17                | 58                 |
| 3X3 ½           | 10254      | 4149        | 854                | 17                | 59                 | 892                | 18                | 56                 |
| 4X3             | 8975       | 3630        | 747                | 15                | 65                 | 780                | 16                | 64                 |
| 3 ½ X3 ½        | 8784       | 3556        | 732                | 15                | 68                 | 764                | 15                | 65                 |
| 5X2             | 10757      | 4356        | 896                | 18                | 55                 | 935                | 19                | 53                 |
| 4X4             | 6730       | 2722        | 560                | 11                | 90                 | 585                | 12                | 85                 |
| 5X3             | 7179       | 2904        | 598                | 12                | 84                 | 624                | 12                | 80                 |
| 5X4             | 5383       | 2178        | 448                | 9                 | 110                | 468                | 9                 | 107                |
| 5X2 ½           | 8611       | 3485        | 717                | 14                | 70                 | 749                | 15                | 67                 |
| 4X2X2           | 18150      | 7348        | 1512               | 30                | 33                 | 1578               | 32                | 32                 |
| 4X2X2 ½         | 16754      | 6783        | 1396               | 28                | 36                 | 1457               | 29                | 34                 |
| 6X6             | 3086       | 1250        | 257                | 5                 | 200                | 268                | 5                 | 186                |
| 5X5             | 4444       | 1799        | 370                | 7 ½               | 135                | 386                | 8                 | 129                |



**Fertilizer Measurements using Containers for Plant Density about 8611/HA OR 1.22m by 0.91m (3485/acre or 5x2<sup>1</sup>/<sub>2</sub> feet spacing)**

- Weigh ½, 1 and 2kg of respective fertilizer.
- Pour the weighed fertilizer into a suitable plastic container and ensure surface is level.
- Mark the level of the fertilizer on the container.
- Remove fertilizer from the container and cut container at the marked level.

| Fertilizer type, actual weight and rate applied |   | Size of the container and weight of fertilizer |       |                                |
|---|---|--|-------|--------------------------------|
|   |   | 2kg  | 1kg   | <sup>1</sup> / <sub>2</sub> kg |
| S/A (21%N)                                      |   | 2700g  | 1350g | 700g                           |
|   | No of bushes at 150 kgN/ha                              | 30   | 15    | 7                              |
| NPK 20:10:10                                    |   | 2500g  | 1250g | 650g                           |
|   | No of bushes at 150 kgN/ha                              | 30   | 15    | 7                              |
| NPKS 25:5:5:5S                                  |   | 2400g  | 1200g | 600g                           |
|   | No of bushes at 150 kgN/ha                              | 35   | 17    | 8                              |
| NPKS 22:6:12:5                                  |   | 2400g  | 1200g | 600g                           |
|   | No of bushes at 150 kgN/ha                              | 30   | 15    | 7                              |
| Urea 46%  |   | 2000g  | 1000g | 500g                           |
|   | No of bushes at 150 kgN/ha                              | 53   | 26    | 13                             |
| SSP 18% P <sub>2</sub> O <sub>5</sub>           |   | 2600g  | 1300g | 650g                           |
|   | No of bushes at 50 kgP <sub>2</sub> O <sub>5</sub> /ha  | 80   | 40    | 20                             |
| TSP 46%   |   | 2800g  | 1400g | 700g                           |
|   | No of bushes at 50 kg P <sub>2</sub> O <sub>5</sub> /ha | 220  | 110   | 55                             |
| DAP 18%N, 46% P <sub>2</sub> O <sub>5</sub>     |   | 2500g  | 1250g | 600g                           |
|   | No of bushes at 50 kg P <sub>2</sub> O <sub>5</sub> /ha | 200  | 100   | 50                             |
| Muriate of potash(KCl) 60% K <sub>2</sub> O     |   | 3100g  | 1500g | 750g                           |
|   | No of bushes at 100 kg K <sub>2</sub> O/ha              | 160  | 80    | 40                             |

## **MANURES**

- Manure should be applied only once in every pruning cycle i.e. immediately before or after pruning.
- Apply only well-rotted/decomposed and dry manure.
- Never apply manure simultaneously with fertilizers.
- Various manuring materials can be used depending on availability e.g. cattle, sheep, coffee pulp and chicken manure.
- Broadcast 1–2kg/bush of manure evenly over the soil surface.

## **FERTILIZERS AND SOIL AMENDMENTS**

When substituting the recommended compound fertilizers as a source of nitrogen with urea, the following conditions should be observed:-

- i) Rates higher than 150 kg N/ha should **not** be applied.
- ii) Application should be done during periods of adequate rainfall.
- iii) If urea as a source of N has to be used continuously, the supplementary P and K should also be applied. In such a case, apply SSP and sulphate of potash or SSP and muriate of potash.

## Straight fertilizers and soil amendments used in tea:

| Name and abbreviation         | % of nutrient |                               |       |                  |       |       |       | Mg |
|-------------------------------|---------------|-------------------------------|-------|------------------|-------|-------|-------|----|
|                               | N             | P <sub>2</sub> O <sub>5</sub> | P     | K <sub>2</sub> O | K     | S     | Ca    |    |
| Sulphate of ammonia: S/A      | 21            |                               |       |                  |       | 24    |       |    |
| Ammonium sulphate nitrate:ASN | 26            |                               |       |                  |       | 12    |       |    |
| Urea                          | 46            |                               |       |                  |       |       |       |    |
| Diammonium phosphate: DAP     | 18            | 46                            | 20    |                  |       |       |       |    |
| Single super: SSP             |               | 20                            | 9     |                  |       | 10-12 | 20    |    |
| Triple super:TSP              |               | 40-46                         | 18-20 |                  |       | 0-2   | 14    |    |
| Rock phosphate                |               | 25-30                         | 11-13 |                  |       |       | 20-30 |    |
| Muriate of Potash             |               |                               |       | 50-60            | 42-50 |       |       |    |
| Sulphate of potash:Sul/K      |               |                               |       | 48-52            | 40-44 | 15-17 |       |    |
| Epsom salts                   |               |                               |       |                  |       | 13    |       | 10 |
| Kieserite                     |               |                               |       |                  |       | 23    |       | 17 |
| Gypsum                        |               |                               |       |                  |       | 19    | 23    |    |
| Sulphur                       |               |                               |       |                  |       | 99    |       |    |
| Aluminium sulphate            |               |                               |       |                  |       | 14    |       |    |
| NPKS 25:5:5:5                 | 25            | 5                             | 2.2   | 5                | 4.2   | 5     |       |    |
| NPKS 22:6:12:5                | 22            | 6                             | 2.6   | 12               | 10    | 5     |       |    |
| NPK 20:10:10                  | 20            | 10                            | 4.3   | 10               | 8.3   |       |       |    |

*The quoted nutrient contents are approximate*

N= nitrogen

S= sulphur

P= phosphorus

Ca= calcium

K= potassium

Mg= magnesium

### ***Leaf sampling***

- It is advisable to have all fields tested once in a pruning cycle, preferably just before pruning.
- Sample towards the end of the cycle (between 4 and 5 months before pruning).
- Each sample should have at least 100 mature leaves. Samples should represent a well-defined area in which the tea is uniform.
- The bushes must be uniformly scattered over the whole area, but avoid; the few rows that adjoin roads, paths, or large vacant patches.
- Do not sample banjhi shoots, or the free-growing shoots on the edge of the plucking table.
- If bush vigour is uneven within a plot, take a separate sample from the weaker areas.
- Each plot must be sampled on the same day.
- Choose a season when the tea is cropping freely, but avoiding abnormal flush crops.
- After application of fertilizer, manure, or mulch, wait for several weeks before sampling.
- Pack the leaves into a clean paper bag and seal with adhesive tape: do not use staples or pins.

***Do not use polythene or cloth bags.***

- Dry the leaf as far possible, but do not crush it,
- Each bag should have the plot description and site written on it, so that it is readily identifiable, Write a covering letter giving details and post the bags in a firm package to:

**Director,  
The Research Foundation of Kenya,  
P.O. Box 820-20200,  
KERICHO.**

### ***Soil amendments***

#### ***1. Sulphur***

- It increase the acidity of too alkaline soils.

- Roots can be damaged if they come into contact with high concentrations of decomposing sulphur.
- Sulphur takes time to reduce the pH of the soil, and this must be allowed for when planting.
- Stumps planted before the sulphur has reduced the pH sufficiently will die.
- The length of time to be allowed between sulphur application and planting depends on the amount of sulphur; allow at least two months for each 115g of sulphur used.
- For field planting, dig holes 46cm in diameter by 76cm deep at the site of each bush.
- Mix crushed sulphur thoroughly with the soil from the hole before refilling.
- The quantity of sulphur required depends on the pH, as follows:

| pH         | Sulphur per hole    |
|------------|---------------------|
| 5.9 to 6.4 | 115g                |
| 6.5 to 6.9 | 225g                |
| 7.0 to 7.4 | 340g                |
| >7.5       | not worthy treating |

## 2. *Aluminium sulphate (14% S.)*

- Is primarily used for acidifying soil.
- It is very soluble in water.
- Acidifies soil without adverse effects on tea; does not damage tea roots even in high concentration.
- 450g of aluminium sulphate has the same effect as 115g of sulphur.
- For tea which is growing but not thriving on hut sites, top dress with aluminium sulphate at 450g per square metre every three months for a year.
- Areas with pH greater than 6.5 treat with as above until tests show that the pH is below 6.0.

## 3. *Brimstone90 (90% sulphur)*

- For lowering high soil pH.

- Easy to handle.
- Use 150 g of brimstone in the planting hole.
- Top dress with 150g Brimstone per plant every 3 months;  
**only when soil is moist**

### **Foliar application of nutrients**

- Recommended where a rapid cure of a nutrient deficiency is required, especially for nutrients which are needed in low concentration in the tissues.
- Foliar nutrition can be useful where a nutrient deficiency arises because soil conditions do not permit efficient up take by the roots.

### ***Recommended foliar nutrients***

#### ***1. Zinc oxide: 70% zinc***

- Oxide is insoluble in water.
- Use only a finely powdered "Spraying-grade" formulation.
- Use spraying equipment with a built-in agitating device.
- Zinc oxide does not scorch tea foliage; use only enough water to achieve a uniform distribution of the spray.

#### ***2. Zinc sulphate: 22 to 24% zinc***

- The form recommended is the heptahydrate, which dissolves in water readily.
- The solution is sufficiently acidic to corrode metallic parts of spraying equipment, which must be washed thoroughly after use to reduce the rate of damage.
- The underside of a tea leaf is more susceptible to zinc sulphate scorching than the upper surface.

#### ***(i) Recommended programmes for the routine foliar application of zinc: Knapsack equipment***

- Spray when the bushes are in a reasonably active state of growth.
- **Never** apply towards the end of dry spell.
- Bushes moderately damaged by hail can be sprayed.

- In case of severe damage with loss of whole leaves, wait for new foliage to develop.
- Spray to give an even cover of small droplets on the leaves in the plucking table.

### 1. *Tea in plucking*

*Either*

Zinc oxide

Method: light foliar spray

Rate: 3 kg per hectare in 20 to 200 litres of water

Timing: repeat at approximately six-month intervals

*Or,*

Zinc sulphate

Method: light foliar spray

Rate: 10 kg per hectare in no less than 200 litres of water

Timing: repeat at approximately six-month intervals

### 2. *Young tea*

- If regular plucking has not yet been established, and if zinc-deficiency symptoms are considered to warrant, treat as above.

## DISEASES AND PESTS CONTROL

### DISEASE CONTROL IN TEA

#### (i) **Armillaria Root Rot** (*Armillaria* Spp.)

##### *Occurrence*

- This is a fungal disease.
- The fungus has a worldwide distribution.
- It occurs in roots of most forest trees without infecting them though sometimes it cause root rot in the trees.
- Initial infection is traceable to woody debris of stumps and roots left in the soil during initial land clearing.
- The fungus spreads and infects tea mainly by contact with infested/infected root material.
- Overtime the spread is seen as radial patches of diseased plants in the tea field.

##### *Symptoms*

- Bushes are stunted.
- Premature flowering, yellowing, browning, defoliation and eventual death.
- Longitudinal cracks appear at the collar region.
- White mycelia growth is found under the bark, overlying the wood, accompanied by the smell of mushrooms.

##### *Control*

- There is no chemical cure to this disease.
- Ring bark trees for at least one and a half years before felling.
- If trees are cut when fresh, remove all the stumps and as much roots as possible from the soil.
- Uproot and dig out all root debris of affected bushes and remove from the field.
- Uproot all tree stumps in the field, removing all root material from the soil.



**(ii) Hypoxylon Wood Rot (*Hypoxylon serpens*)**

- Is also a fungal disease.
- The disease causes considerable damage to tea in India and Sri-Lanka and has been observed to be serious in some tea growing areas of Kenya.
- Also causes wood rot in several dicotyledonous forest trees.
- The disease is spread by wind and water (rain-splash).
- The fungus enters its host through wounds caused by pruning, sun scorch and hail damage.

*Symptoms*

- Die back and rotting of primary branches or stems.
- The whole bush may die.
- The dead branches are very light.
- Dark grey to black tar-like patches of various shapes and sizes are present on the bark of infected branches.

*Control*

- The disease has no chemical cure; only preventive measures can be taken.
- Prevent sun-scorch by shading, branch with prunings immediately after pruning.
- To prevent spread of the disease to the whole bush and to uninfected bushes, dead and dying branches **MUST** be pruned down to the healthy wood and prunings removed from the field.
- Pruning cuts should be made sloping so as to allow run-off of rain water.
- Large pruning cuts should be dressed over with protective paint of fungicide such as copper in raw linseed oil.
- Avoid down pruning/running of tea. If this has to be done, wounds should be dressed as a mandatory requirement.
- Avoid splitting of stems and branches and large cuts during pruning.
- Avoid wounding of plants during manual weeding.

### **(iii) Collar and Branch Canker (*Phomopsis theae*)**

#### *Occurrence*

- Is a fungal disease with a worldwide distribution.
- Occurs in all tea growing regions of Kenya.
- Innoculum can be spread by wind.
- Canker formation progresses more rapidly when plants are water stressed (as in drought).

#### *Symptoms*

- Canker lesions (knots) develop on the stem at the collar region of branches.
- Upper edges of lesions are heavily callused.
- Leaves on branches girdled by lesions turn yellow and ultimately the branch dies.
- Where lesions girdle the main stem, the whole plant dies.

#### *Control*

- There is no chemical cure and preventive measures have to be taken.
- Minimise injuries on the bark.
- Avoid moisture stress by mulching.
- To check the spread, prune affected branches least 10cm below the lesions.
- Paint pruning cuts with a fungicide such as dithiocarbamates or copper oxychloride mixed in vegetable oil at the ratio 1:1.
- Remove all infected plant material (including prunings) from the field and burn.

### **(vi) Cyindrocarpon Root Rot (*Cyindrocarpon tenue*)**

#### *Occurrence and Symptoms*

- Is a soil-borne fungal disease.
- The root system is infected causing rotting of the tissues.
- Surface of infected root appears pink in color.
- The plant wilts gradually and ultimately dies.

- The disease is rare in tea and is of minor importance in Kenya.

#### *Control*

Uproot infected plants, remove from the field and destroy.

### **(vii) Crown Gall (*Agrobacterium tumefaciens*)**

#### *Occurrence and Symptoms*

- Is a bacterial disease, which enters roots of plants through wounds, created by physical injuries.
- In infected tissue, excessive cell division (hypoplasia) and enlargement (hypertrophy) are induced.
- The result is abnormal growth and formation of galls/tumours at the collar region of the plant.
- Such plants appear unhealthy and unable to withstand other stresses and may ultimately die.

#### *Control*

- Avoid physical injuries to the roots especially during manual weeding.
- Uproot and destroy infected plants.
- There is no effective chemical cure.

## **PESTS CONTROL IN TEA**

### **Tea Mites**

#### **(a) Red Crevice Mite or Scarlet Mite (*Brevipalpus phoenicis*)**

#### *Occurrence*

- All tea-growing areas of Kenya.
- Attacks are serious during dry periods especially in the East of Rift.
- Unfertilised and overfertilised tea is preferred.

### *Symptoms*

- Main vein under the leaves turn brown and corky especially near the petiole.
- Leaves dry up and fall prematurely.
- Crevices are found along the stem; they are lined with red coloration (the mite or its eggs).

### *Prevention*

- Adequate (recommended) fertilizer application.

### *Control*

- Spray with either:-
  - ◆ Karate 2.5 WG at 1g/litre
  - ◆ Omite at 3ml/liter

***Allow 14 days interval before plucking.***

## **(b) Red Spider Mite (*Oligonychus coffeae*)**

### *Occurrence*

- Occurs throughout Kenya especially on unshaded tea.
- Infestation is low in most tea-growing regions in Kenya.
- Has a number of alternate hosts.
- Natural enemies include ladybird beetle, predatory mite (*Phytoseulus pesselilus*) and lacewing larvae.

### *Symptoms*

- Upper surface of mature leaves darker, turn brown, and dry up.
- Young leaves may also be attacked during severe drought.
- Severe attacks may lead to defoliation.
- Mites (0.5mm) can be seen on upper surface of leaves, they are red (front) and purple (rear).
- White skin casts of immature stages can be seen with the small reddish eggs alongside leaf veins.

### *Control*

- Spray with either:-
  - ◆ Karate 2.5 WG at 1g/litre

- ◆ Omite at 3ml/litre

***Allow two weeks interval before plucking.***

**(c) Yellow Tea Mite (*Hemitarsonemus latus*)**

*Occurrence*

- Occurs in low numbers in most tea growing areas of Kenya.
- Nursery may be heavily infested especially when heavily shaded.
- Has a wide range of alternative hosts.

*Symptoms*

- Young leaves are curled and may be distorted.
- The under side of the leaves may turn brown and corky in between the veins
- Adult yellow tea mites (1.5 mm long) appear yellow.
- Singly laid eggs covered with whitish cast tubercles may be seen on under side of leaves.

*Control*

- Spray upper side of leaf with:-
    - i) Karate 2.5 WG at 1g/liter
  - Repeat spray after one week if mites persist after first spray.
- Allow one week before plucking.**

**(d) Purple Mites (*Calacarus carinatus*)**

*Occurrence*

- Occurs in all tea-growing regions of Kenya.
- Population is kept low by proper nutrition of tea.
- Mites prefer unfertilized or inadequately fertilized bushes.

*Symptoms*

- Attacked leaves appear purple or bronze in colour.
- Whitish skin casts seen scattered on the leaf surface.
- Attack is prevalent on upper leaf surface.

- Older leaves are preferred but in severe attacks, young leaves are also infested.
- Defoliation occurs in serious attacks especially on young tea.

#### *Prevention*

- Adequate (recommended) fertilizer application control.

#### *Control*

- Spray with
  - i) Karate 2.5 WG at 1g/liter

***Allow two weeks interval before plucking.***

### **(e) Bud mite (*Brevipalpus corlifornicus*)**

#### *Occurrence*

- Incidences are very rare.
- The microscopic mites attack the apical buds.

#### *Symptoms*

- Newly unfolding leaves are curled and dissected and look like a fern.
- Leaves are hardened.

#### *Control*

- Spray upper side of leaf with either
  - i) Karate 2,5 WG at 1g/liter

Repeat spray after one week if mites persist after first spray.

***Allow one week before plucking.***

### **Common cutworms (*Agrotis segetum*)**

#### *Occurrence*

- They can cause damage in nurseries and newly planted fields
- A common pest of young tea in all tea-growing areas.
- The pests hide in the soil near their hosts by day and surface on the soil at night to feed.

### *Symptoms*

- The caterpillars are grey brownish in colour and are up to 4.5 mm long.
- They eat bark of stems at ground level.
- This is followed by extensive callusing and swelling around the collar.

### *Control*

- Use of baiting material either bought or prepared. The recommended formula (for 1 Ha) is as described for control in nursery.

## **Citrus aphid (*Toxoptera aurantii*)**

### *Occurrence*

- Found in all tea growing districts of Kenya.
- Nurseries are more often attacked but can be found on mature tea.

### *Symptoms*

- Brown aphids (up to 3mm long) are found in large numbers on the youngest shoots and leaves.
- Affected leaves curl backwards.

### *Control*

- Spray affected parts of the plants with either:-
  - i) Karate 2.5 WG at 1g/liter

***Allow minimum one-week interval before plucking.***

## **Scale insects: Soft green scales, soft brown scales, fried egg scales (*Aspidiotus sp.*)**

### *Occurrence*

- Occur sporadically in all tea-growing districts in Kenya.
- Fried egg scales are prevalent in Tigania Nyambane and parts of Kericho.

### *Symptoms*

- The insects are found along midribs and upper and lower surfaces of leaves especially in newly planted tea.
- They appear as the name describes i.e. soft green, soft brown or fried egg.
- Sometimes leaves turn black with sooty moulds and ants may be active on affected leaves.

### *Control*

- Pruning; to remove most leaves and allow parasite wasps to attack the remaining scales.
- Spray with Karate 2.5 WG 1g/litres water mixed with 5ml Dc-Tron or DC-Tron only at 10 ml/litre
- Respray after two weeks if necessary.
- Control ants (which may spread attack) by spraying with Cyrene 48% EC at 1-5 ml/litre of water around bare of attacked bushes.

***Allow minimum of 1 week before plucking.***

### **Moths and butterflies**

- Damage is caused by larvae (caterpillars) as they feed on the foliage.

### *Control*

- Spray with either
  - i) Dc-Tron 10ml/litre of water.
  - ii) Karate 2.5 WG at 1g/litre of water.

***Allow one week before plucking.***

### **Faggot worm (*Clania destrucior*)**

#### *Occurrence*

Is a minor pest found in some tea growing areas, such as Murang'a.

### *Symptoms*

- The larvae live in cases of different shapes and sizes.



- The cases are made of bits of twigs placed parallel to each other along their length with an aperture in the middle through which the larva protrudes its head and feeds on the leaves and bark of tea bushes.

#### *Control*

- No chemical control measures have been tested.
- Is best efficiently removed by hand as soon as they appear.

### **Leaf eating caterpillars (various)**

#### *Control*

- Spray with either
  - i) Karate 2.5 WG at 1g/litre of water
  - ii) DC-Tron at 5ml/litre of water.

***Allow at least one week before plucking.***

### **Beetles - Cockchafer larvae (*Schizonycha spp.*)**

Found generally on immature tea.

#### *Symptoms*

- Leaves of young bushes wilt and the surface of the root is seen to be damaged especially just below the soil surface.
- This damage is frequently followed by extensive callusing and swelling around and below the collar.
- Damage is similar to injury caused by chemical fertilizers coming into contact with the collar of the plants.

#### *Control*

- Spray the soil around the bushes with Dursban (*Gladiator*) at the rate of 10ml/litre of water.
- Planting holes can be sprayed before planting.
- For nurseries, treat the soil of new nurseries before planting (at the same rate as above). Incorporate endosulfan with the top 10cm of soil.

## Tea Weevils

### (a) Tea Root Weevil (*Aperitmetus brunneous*)

#### *Symptoms and Occurrence*

- The pest girdles the stem just above ground level.
- The plant wilts and dies.
- The larvae feed on taproots growing along the channel of the root causing wilting, stunting and finally death of the plant.

### (b) Nematocerus Weevil (*Nematocerus sulcalus*)

#### *Symptoms and Occurrence*

- Adult weevil feeds on leaves making characteristic notch – like damage to leaf margins.
- In severe attacks, almost total defoliation can occur.
- The larvae live in the soil and eat the roots, underground stem and germinating seed.

### (c) Systates Weevil (*Systate sp.*)

#### *Symptoms and Occurrence*

- Adult weevils eat the leaf margin causing fiord-like (notch–like) indentations.
- In severe attacks, there is almost complete defoliation.

### (d) Kangaita/Kimari weevil (*Entypotrachelus meyeri*)

#### *Symptoms and Occurrence*

- Adult weevils eat the leaf margin causing fiord-like (notch – like) indentations.
- In severe attacks there is almost complete defoliation.

#### *General Control*

- Spray the soil surface with Karate 2.5 WG at 1g/litre of water.
- Hand picking of pest is effective where populations are not high.

## **Nettle grubs (Stinging Caterpillars) (*Parasa vivida*)**

### *Occurrence*

- Is a pest of coffee in Kenya, which occasionally attacks tea.
- It occurs in some parts of Murang'a, Embu and Meru (South Imenti).

### *Symptoms*

- Full-grown larvae are pale green and may grow to 45cm.
- They are found on the underside of bushes.
- They have tufts of hair or a series of spines, which are poisonous and painful.
- Their presence makes it difficult to work in an infested area. Workers are reluctant to pluck infested tea.

### *Control*

- Spray affected bushes with Karate 2.5 WG at rate 1g/litre of water.

***Allow one week before plucking.***

## **Tobacco Cricket (*Brachytrypes membranaceus*)**

### *Occurrence and Symptoms*

- The pest has assumed economic importance in some parts of Kenya (Nandi District).
- Young plants are cut a few centimeters from the ground.
- Very little of the plant is eaten. The cut plant dies.

### *Control*

- Spray soil around bushes with Dursban (Gladiator) 48% EC at 10ml/litre of water once a month from planting for at least 3 months.
- OR prepare baits as follows and place inside the cricket tunnel:-
  - ◆ Dursban, Cyren or Tricel – 10ml
  - ◆ Wheat bran – 500 gms
  - ◆ Sucrose (Sugar/Molasses) – 25 gms

## Thrips

- These occur in all tea-growing areas of Kenya.
- They cause serious damage during the dry season.
- With the onset of the rains, populations reduce drastically and attacks die away naturally in wet weather.

### (a) **Yellow Tea Thrips** (*Scirtothrips kenyensis*)

#### *Occurrence and Symptoms*

- The insects are mostly found within the folded terminal buds
- Young leaves are stunted, cupped and margins are cracked and brown changing to purple.
- A pair of brown lines one on each side of the leaf and parallel to the main vein (as caused by yellow tea mite).

#### *Control*

- Intensity of attack can be reduced by finer plucking to remove immature shoots.
- In severe attacks spray with either:-
  - i) Karate 2.5 WG at 1g/litre of water.
  - ii) DC-Tron at 5ml/litre of water.

***Allow at least one week before plucking.***

### (b) **Black Thrips** (*Heliothrips haemorrhoidalis*)

#### *Occurrence and Symptoms*

- The insect is dark brown or black, 1.5mm long with whitish legs and antennae.
- Eggs are laid on the leaves.
- Severe infestations are prevalent in Meru District.
- Silver patches with black spots appear on underside of mature leaves.
- In severe attacks, both leaf surfaces are attacked and immature leaves may be damaged.

#### *Control*

Spray foliage with either:-

- i) Karate 2.5 WG at 1g/litre of water.
- ii) DC-Tron at the rate of 5ml/litre of water

***Allow at least one week before plucking.***

Thrips may become noticeable again about three months after spraying. If satisfactory amounts of rains occur, populations may not build up in sufficient numbers to justify a further spray for several months.

### **Helopeltis (*Helopeltis schoutedeni*)**

#### *Occurrence and Symptoms*

- Is a mosquito bug, 1.5 cm long, red with black wings, which feeds by sucking.
- They feed on young tender shoots causing serious damage to tea (Pluckable tea).
- Dark brown spots up to 4 mm in diameter appear on the youngest leaves and shoots.
- The spots exude moisture from the center when fresh, which turns black and produce leaf and stem distortions as the growing tissue, expands.
- In severe infestation, green shoots are attacked which, can later lead to branch canker.

#### *Control*

- Spray foliage with Karate 2.5 WG at 1g/litre of water.
- Spray foliage with DC-Tron at the rate of 5ml/litre of water

***Allow at least one week before plucking.***

### **Ants**

- These do not damage tea directly but are a nuisance to workers. Some species construct nests on tea bushes using the leaves and ultimately defoliate the bush.

#### *Control*

Destroy the nests and spray the nests and affected bushes with Karate 2.5 WG at 1g/litre of water.

***Allow at least one week before plucking.***

## **Termites**

*Microtermes natalensis* - live wood termites

*Pseudocanthotermes militaris*

### *Occurrence*

- Occur most frequently on recent plantings.
- Plants wilt and die.
- The stem beneath the soil surface is ring barked or the entire system may be destroyed.
- Older plants may be stripped of leaves
- Earthen tubes are generally present on the main stem and sometimes also on branches.

### *Control*

- *Pre-treatment attention:* Remove dead wood and snags and hollowed out branches by pruning back to live wood and covering the cut surface with protective paint of copper in raw linseed oil.
- Spray soil around plants with Tricel or Cyren at 10ml/litre of water.
- Destroy termite nest and remove the top and treat with Tricel or Cyren at 10ml/litre of water.

## **WEED CONTROL**

### **Weed control is necessary;**

- For improvement of tea yields and quality.
- To eliminate competition for moisture and nutrients.
- Weed infested tea shows more moisture stress during dry periods.
- Weed infested tea is more likely to exhibit nutrient deficiency symptoms.

### **Weed control methods**

Involve cultural, chemical and integrated weed management.

### *Cultural methods*

- 1) Cultivation (cheel hoe, jembe, panga)
  - causes damage to tea roots.
  - not encouraged, especially in young tea.
  - if used, should be shallow cultivation (cheel hoeing).
  - only effective on young shallow rooted annual weeds.
- 2) Slashing
  - Can be done to reduce foliage on overgrown weeds before chemical spraying.
- 3) Cover/ nurse crop
  - Applicable only on young tea.
  - Involves planting a crop e.g. oats in the inter rows.
  - Recommended for use in young tea.
- 4) Mulch
  - Suppresses weed growth.
  - Conserves soil moisture.
  - Regulates soil temperature.
  - Provides organic matter on breakdown.
  - Recommended for use in young tea.
  - In mature tea, is composed of prunings.

### *Chemical methods*

- Weed control can be effected during rainy season when it is too wet for cultivation.
- Weed control can be effected alongside other operations (requires very little labour).
- Mulch lasts longer than with cultivation.
- Effective for control of perennial weeds.

### *Integrated weed management*

- Is a combination of cultural and chemical weed control methods within a weed management programme.
- Is the most effective weed control method.

Any weed control method applied will only be effective if effected before weeds set seed or before developed underground organs mature.

### **Recommended herbicides**

*Soil applied (persistent) herbicides.* Diuron, Oxyfluorfen

- Applied pre- or post- weed emergence.
- Has little or no effect on standing weeds.
- Fields should be cleaned prior to application.
- Applied on moist soils or when rains are expected within 48 hours (i.e. at onset of rains).
- Can be applied as tank mixture with contact herbicide on standing (but not dense) weeds.

*Foliar applied herbicides*

- Applied post weed emergence
  - Ineffective on overgrown dense vegetation
- a. Translocated (systemic) herbicides. Glyphosate, sulfosate, plyphosate.
- Effective on perennial weeds with underground parts.
  - Avoid cultivation/ tillage before application for proper translocation to underground parts and good vegetative cover to intercept chemical spray.
  - Do not apply in wet weather. Requires 7 – 48 hours without rain after application.
- b. Contact herbicides. Glufosinate ammonium,, Diquat.
- Can be applied in wet weather but not heavy rain.
  - Can be applied as tank mixture with soil applied herbicides.
  - Ineffective on perennial weeds with underground parts.

### **Use of herbicides**

- Where the weed infestation is very dense, slash the weeds down as close to the ground as possible.
- Remove the vegetation and carry off the field.



- Follow as soon as possible (within a day or two) with a spray of Basta.(2l/ha).
- Remove the unscorched weeds manually using a cheel hoe before they seed. This should take place between one and two weeks after the Basta application. If there is a large amount of vegetation removed, it is best to carry off the field.
- Follow with application of a persistent herbicide (diuron or oxyfluorfen). Apply as tank mixture with Basta if application is made after regrowth.
- Resistant rhizomatous and woody plants which continue to grow must be removed before they are able to become strongly established or seed.
- Deal with couch grass, if present, by using Dalapon or glyphosate (the absence of soft weeds at this stage makes it easy to see and treat).
- Remove other species by hand or using a contact herbicide. If a contact herbicide is used, large and tap-rooted plants should be pulled out of the ground and laid down before spraying.

Whether manual or chemical treatments are used, ensure that weeds are dealt with before they seed.

Where initial weed density is not high, commence with the application of the persistent herbicide at the time of pruning only.

### **Spot spraying**

- The herbicide spray must be directed on the leaves only.
- Use a fine spray jet to reduce the risk of over-dosing.
- Avoid herbicide drift to tea bushes.
- Where the weeds are small (up to 5 cm tall) thoroughly wet the foliage.
- If the weeds are larger cut them down and allow regeneration before spraying.

### **Weed control in young tea**

Weed control in young tea is an essential and mandatory operation

compared to that in mature tea.

- Eradicate difficult and perennial weeds e.g. Kikuyu and couch grass during land preparation.
- Avoid use implements (cheel hoe, jembe, fork jembe etc) as these inevitably results in heavy damage to roots and loss of both tea plants and nurse crops
- Keep a circle of at least 40 cm diameter around each young tea plant completely clear of weeds.
- Pull these out individually by hand, put into a sack and carry off the field.
- Cover the ground outside the circle (inter rows) with mulching material or a nurse crop (such as oats which when cut and laid down, will act as mulch and also reduce weed growth).
- Remove weeds growing through the mulch by hand along with rowing oats too close to the tea plants.
- Alternatively, control them with Paraquat (gramoxone), at the rate of 310 ml of the product in 124 litres of water per hectare. (Paraquat will check the growth of oats but will not kill them unless applied very frequently in heavy doses).
- Prevent herbicide damage to tea plants by shielding the plants when spraying. This can be done successfully in a number of ways:-
  - ◆ A piece of polythene sheet can be held around each plant by one man while another man sprays the weeds.
  - ◆ A four-gallon (20 litre) tin (debe) cut into halves or a cone made from any stiff material, which is easily dropped to cover individual plants, can be used by one man who does the spraying as well. The cones, if made from material of sufficient gauge and rigidity, have proved to be simple and effective.
- Minimise drift when spraying any herbicide to the young plants which are not protected.
- A flood jet at reduced pressure gives a coarser spray which is less easily carried by wind.
- Alternatively, a Dribble-bar attached to a pressure sprayer

produces coarse drops and has been used successfully.

- Always avoid spraying under very windy conditions.
- Repeat weeding rounds, whatever method of control is employed, after a short interval to remove regrowing weeds before they seed or grow extensive root systems.

#### *Herbicide use in young tea*

- A persistent herbicide sprayed over fields of young tea will prevent seedlings of many weeds from growing.
- Simazine must be **used with caution** as young tea plants have on occasions been damaged by Simazine.
- Dalapon **must not** be used on tea **under two years old**.
- Where perennial weeds such as sedges, couch or Kikuyu grass are the problem, Glyphosate (roundup) can be used effectively.
- Other herbicides which can be considered for young tea under two years old are Fluroxypyr-butyl (Fusilade), oxyfluorfen (Goal 2E), Kamata, and Basta.

In all cases, precaution should be taken to protect the young plants when spraying herbicides.

#### **Weed control in mature tea**

- Apply an annual spray with a persistent herbicide
- Kill subsequent regrowth if they are small; by hand weeding or by applying a foliar applied herbicide.
- Keep soil disturbance during weeding to a minimum as soil brought up from deeper horizons brings up fresh supply of weed seeds. Tea roots will be damaged, reducing the nutrient uptake of the bushes and making points where *Armillaria* or any other soil borne pathogens can enter.

**Table 1: Recommended herbicides**

| <b>Common name</b>               | <b>Chemical family</b>                          | <b>Dilution rate (mls or g/ltr of water)</b> | <b>Target weeds</b>                    | <b>Precaution</b>          |
|----------------------------------|---|--|--|----------------------------|
| Roundup                          | Glyphosate                                      | 12 - 25 ml                                   | Grasses, sedges and broad leaved weeds | Not sprayed on crop plants |
| Touchdown                        | Sulphate  | 12 - 25ml                                    | Grasses, sedges and broad leaved weeds | Not sprayed on crop plants |
| Round up                         | Glyphosate 360g/L as acid or 450g/L as IPA salt | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Wiper super 360 SL               | Glyphosate 360g/L                               | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Touchdown forte 500 SL           | Glyphosate 500g/L                               | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Round up turbo 450 SL            | Glyphosate acid 450g/L                          | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Glyfos 360 SL                    | Glyphosate 360g/l Isopropylamine salt           | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Woundout 480 SL                  | Glyphosate IPA salt 480g/L                      | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Weedal 480 SL                    | Glyphosate IPA salt 480g/L                      | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Clinic 480 SL/ Gly 480 SL        | Glyphosate IPA salt 480g/L                      | 12 - 25 ml                                   | Annual and perennials weeds            | Not sprayed on crop plants |
| Glycel 480 SL                    | Glyphosate 480g/l (as IPA salt 40.60% w/w/)     | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Roundup energy 450 SL            | Glyphosate potassium salt 450g/L                | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Manifest 360 SL                  | Glyphosate 360gG/L (as free acid) .             | 12 - 25 ml                                   | Grasses and other perennials           | Not sprayed on crop plants |
| Basta 20 SL Water soluble Liquid | Glufonisate ammonium 200g/L                     | 12 - 25 ml                                   | Grasses, broad leaved weeds shrubs     | Not sprayed on crop plants |
| Mamba                            | Glyphosate                                      | 12 - 25 ml                                   | Grasses, sedges and broad leaves weeds | Not sprayed on crops       |
| Kalach                           | Glyphosate                                      | 12 - 25 ml                                   | Grasses, sedges and broad leaves weeds | Not sprayed on crops       |
| Wipeout                          | Glyphosate                                      | 25 ml  | Grasses, sedges and broad leaves weeds | Not sprayed on crops       |

*Note: In most cases, spot spraying is done on a few bushes in a field. Therefore dilution rate is preferred to rates/hectare.*

## **General precautions when using pesticides**

- Read the label on the container carefully and follow the instructions.
- Use protective clothing such as goggles, gloves, apron, and boots when handling and spraying pesticides.

- When spraying, wear a label with the name of the pesticide being used. (For identification of the chemical being used in case of accident where the victim is unconscious to facilitate proper treatment).
- Avoid smoking or eating while handling pesticides.
- Keep Soap, water and a towel nearby when mixing and using pesticides.
- Avoid windy conditions and subsequent spray drifts where possible. Stand up-wind so that spray drifts or splashes blow away.
- Maintain application equipment in good condition so that leakages are minimised.
- Do not blow clogged nozzles with mouth but clean them with water.
- After spraying, the contaminated clothing should be removed at once.
- Wash contaminated clothes and body after work.
- Label all remaining chemicals, keep in original containers and under lock and key.
- Destroy empty containers away from water sources.

### ***In case of accident***

- If a pesticide is ingested accidentally, induce vomiting at once if not already occurring or administer activated charcoal, as indicated on label
- Send patient to the nearest hospital immediately.
- Vomiting can be induced by drinking a concentrated mixture of common salt in warm water or as indicated on label.
- In case of skin contact with pesticides, wash off with soap and water immediately.
- In case of eye contact, flush out with water for at least 15 minutes and then consult a doctor at once.

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