

Answers to frequently asked questions on field practices in tea

History of tea growing:

Q: Where tea was first originated?

A: According to Dr. Wight, tea might have originated in the region around the point of intersection of latitude 29° N and longitude 98° E near the source of the river Irrawaddy, which is the meeting ground of Assam, North Burma, South West China and Tibet.

(Source: Science & Practice of in Tea Culture, 2008, p22)

Q: What is Sanjivini plant?

A: Some scholars opine that the **sanjivini plant** which was used to heal **Lakshmana** of his wounds was none else but tea(though belonging to the mythical realm).

(Ref: Dutta. Arup Kumar, TRA Concourse, 2011, A National Drink, P 179)

Q: What is the latitude and longitude of tea growing areas of N.E. India?

A: Tea growing areas of N.E. India lie between 24° and 27°N latitudes and 88° – 95° E longitudes.

(Source: Science and Practice in Tea Culture, 2008, p34)

Q: When tea cultivation started in Assam, Darjeeling, Terai, Dooars and Cachar district of Assam?

A: Assam : 1837 at Upper Assam (Science and Culture, vol.77, no.9-10, 2011, p 391)
 Darjeeling : 1856 at Tukvar,
 Cachar : 1856 in the valley of river Barak.
 Terai : 1862 at Champta
 Dooars : 1874 at the east of Teesta river,

Q: What is the height of teelas (hillocks) found in Cachar?

A: The teelas rarely rise above 150 m in Cachar.

(Ref: Science and Practice in Tea Culture, 2008, p35),

Q: From where tea seeds came to N.E. India?

Ans:

- a) 80,000 seeds were imported from China in the year 1835 and germinated in the Calcutta Botanical Garden.
- b) Seedlings were sent to Assam (20,000), and other parts of India for experimental cultivation. (Ref: Notes on Field Management in Tea, 2002, p 1)

Q: Where tea seed bari was first established?

Ans:

- a) The first seedbari was established in Cachar in 1860 by importing seeds from Burma. Gradually seedbaries were established in different areas of Bramaputra Valley.
- b) Seed jats derived their names from the tea estates where the seedbaris were established. (Ref: Notes on Field Management in Tea, 2002, p1)

Weather

Q: What is the difference between fog and dew?

Ans.

- a) Thick fog is formed under conditions when the atmosphere is charged with moisture and the temperature and wind velocity remain low.
- b) Fog condenses into dew when temperature drops below dew point (7°C) and gets deposited on leaves and stems of the tea bushes, weeds and shade trees.

(Source: **Two and a Bud**, vol.37, No.1, 1990, p 4-6)

Q: What is the difference between precipitation and rainfall?

Ans.

- a) The term precipitation is used to mean drizzle, rainfall, snow fall and hail storm.
- b) The form of precipitation may be classified as drizzle or rain. Drizzle consists of water drops smaller than 0.5 mm in diameter. The size of the rain drop varies between 0.5 mm and 5 mm diameter. The drops of rain are stable up to 4.6 mm. The drops bigger than this size break-up into a number of smaller drops.

(Source: **Soil and Water Management by Dr. Bhupal Singh**, p 3)

Q: What happens inside the plant system during drought?

Ans:

- a) Water is absorbed by the roots and sent up through the stems to the leaves from where it is transpired through the minute pores called 'stomata' found on the under surface of leaves.
- b) But this process continues till the plant can extract water from the soil. As the soil moisture starts depleting, it becomes extremely difficult for the roots to extract water from the soil and this is called **moisture stress**.
- c) As the stress continues closure of the stomata takes place and this closure of stomata interferes with the process of photosynthesis and carbohydrate is no longer produced. But this does not reduce the consumption of food by the plant.
- d) During prolonged drought the reserves in the stems and roots are used up by the plant. After a long period of drought the leaves become burnt or dried up and fall off.

(Ref: **Handique A.C. 1992,; Some salient features in the study of drought resistance in tea, Two and A Bud**,2, p 16-18)

Q: What is transpiration?

A: Plants absorb large volumes of water from soil to perform various metabolic functions and most of the water is lost through leaves to the atmosphere as water vapour. This process of releasing water to the atmosphere through the leaves is called transpiration.

(Ref: **Barman T. S. 1997: Transpiration in tea, Two and a Bud**, vol. 44, 2, p.8-11)

Q: What is relative humidity?

A:

- a) The air around us is a huge reservoir of water which it holds in the form of invisible water.

- b) Relative humidity is the moisture content of a volume of air expressed as a percentage of the maximum quantity that the air can hold at the prevailing temperature.

Q: What is the definition of rainy day?

- A. A rainy day is defined as one on which at least one hundredth of an inch rain falls.
(Annual Scientific Report, 1968-69, p 48)

Q: What is the difference between erodible rain and non-erodible rain?

- A. Rainfall of 38 mm (1.5 inch) or above per hour for a period of 5 minutes or more duration is considered as erodible rain and rainfall less than 38 mm (1.5 inch) per hour is taken as non-erodible rain. (Source: Annual Scientific Report, 1968-69, p 48)

Q: May we get some basic idea about the climate of tea growing areas of N. E. India?

A: Basic climatic conditions are as follows:

- a) Longitude : 94°12' E
- b) Latitude : 26°47'N
- c) Elevation : 96.5 meter amsl (Above Mean Sea Level),
- d) Temperature : Lowest 7°C (January), Highest 36.5° (July)
- e) Rainfall : 2000 mm/year (some areas have up to 5000 mm rains)
- f) Climate : Humid tropic
- g) Soil acidity : pH 4.0 – 5.0
- h) Wind speed : Minimum 13.2 km /day in December, maximum 59 km in July
- i) Soil : in general sandy loam

(Source: TRA)

Formation of soil & soils of tea growing areas of N E India

Q: How soil was formed?

A: Soil is the end product of a slow natural action known as weathering in which rocks and minerals on the earth surface are broken down into very small particles over thousands of years.

Q: How weathering of rocks took place?

A: Weathering is the process of many factors like water, temperature, microbial activity etc:

Weathering
Rocks ----- soil
Physical- Disintegration
Chemical- Decomposition

Q: How many types of soil we are having?

A: Broadly there are four types of soil. They are as follows:

- a) **Alluvial soil** (i.e. soil transported by water): Alluvial soils are formed from materials deposited by rivers. Soil under tea in N.E. India is predominantly alluvial soil **except Darjeeling** where soil developed in situ.
- b) **Aeolian soil** i.e. soil transported by wind
- c) **Glacial soil** i.e. soil transported by Ice.
- d) **Residual soil** i.e. soil remained at the place of origin (as in **Darjeeling**).

Q: Will you please tell us the composition of our soil?

A: Composition of soil is as follows:

Soil is composed of mineral matter (45 – 50%) + organic matter (1-5%) + air & water (50%).
Coarse sand, fine sand, Silt & Clay are the mineral matters or particles.

Q: What are the sizes of these particles?

A: Size groups of **mineral matters** are as follows:

Coarse sand	- size	2.0 mm to 0.2 mm	in diameter
Fine sand	- “	0.2 mm to 0.02 mm	“
Silt	- “	0.02 mm to 0.002 mm	“
Clay	- “	Less than 0.002 mm	dia.

Q: What is soil texture?

Ans:

- a) The proportion in which different sized mineral particles are present in any soil is referred to as **soil texture**.
- b) A loamy texture is **suitable for most situations** as it combines the water holding capacity and CEC (Cation Exchange Capacity) of the clays with drainage and porosity of the sand to help good aeration for root growth.

Q: What is the role and composition of organic matter?

Ans:

- a) Organic matter is a bio-degradable product of plants and animal origin.
- b) It is the store house of microbes involved in enormous activities including binding of the soil particles.
- c) The enriched organic matter lies in the upper surface of the **soil profile** and diminishes with the increasing depth of the soil.
- d) Average composition of soil organic matter (OM) is 47% C, 44% O, 7% H, 2% N and very small amount of other elements.
- e) Organic matter contains 58% organic carbon. Organic carbon is one of the sources of energy for microbial activities.

Q: What is soil aggregates?

A: The aggregation of soil particles (Sand, Silt and Clay) into larger granules give the soil some unique properties that favour plant growth.(1)

Q: What is the role of soil aggregates in plant growth?

A: Aggregated soil becomes more permeable to water, air and plant roots and the aggregates possess high water holding capacity and cation exchange capacity. Such soils are more resistant to erosion by rain and wind.(1)

Q: How aggregates are formed?

A: Humus produced by the decomposition of organic matter binds the soil particles like glue into granules (aggregates). Hence aggregation of soil is chiefly a biological process for which organic matter is essential. (1).

(1: Science and Practices of Tea Culture by DR. D.N. Barua, 2008, p 142)

Q: Is there any reliable indicator plant to confirm the suitability of land for tea growing?

A: According to Mann Albizzias are reliable indicators of land suitable for tea growing.

Besides Albizzias, a shrub, *Melastoma malabathricum*, bearing pink coloured flowers is considered to be a reliable indicator of land suitable for tea growing.

(Ref: Science and Practices of Tea Culture by DR. D.N. Barua, 2008, p 154)

Q: How soil becomes acidic?

Ans:

- a) Tea soil is mild acidic (i.e. pH between 4.5 and 5.5).
- b) Acidic soils occur in humid regions and are formed due to:
 - i) Leaching of bases like Calcium and Magnesium in heavy rainfall areas
 - ii) Soils themselves originating from acidic parent materials
 - iii) Continuous application of acid forming fertilizers like SOA at very high dose,
 - iv) Accumulation of organic matter and their decomposition products as under forest conditions.
- c) However in most cases, acid soils are formed due to leaching of bases (calcium and magnesium) in regions of high rainfall.

(Ref: Hand Book on Fertilizer Usage, p 158- 159)

Q. What is meant by the term pH?

Ans:

- a) The term pH is of German origin. The symbol 'H' stands for Hydrogen ion (H^+) activity (Ref: Science Reporter, July 1978, p 437).
- b) The symbol pH is used to indicate acidity or alkalinity of the soil. It is measured on a 0-14 scale. At pH 7 the number of **hydrogen (H^+)** ions and **hydroxyl (OH^-)** ions is equal ($7 + 7 = 14$).
- c) The solution is called acidic when pH varies between 0 and 7 and solution 7 it is called Neutral and pH from 7 to 14 is called alkaline.
- d) An acid soil has more of H^+ ions while an alkaline soil has more of OH^- ions (H stands for acidity and OH stands for alkalinity).

For example:

At pH 5: $OH=5$ (out of 14), thus $H = 9$, result is acid soil

At pH 7: $OH=7$ (out of 14), thus $H = 7$, result neutral soil

At pH 9: $OH= 9$ (out of 14), thus $H =5$, result alkaline soil

(Ref: Quoted from the book 'Fertilizer Guide' by Dr. HLS Tandon, 3rd Edition p 17)

Q. What is the suitable range of soil p^H for tea growing?

A: The most suitable range of soil p^H for tea growing lies between 4.5 and 5.5.

(Ref: Notes on Field Management in Tea, 2002, p 120)

Q.What will be the impact of low soil pH (below 4.5) on crop and productivity of tea?

Ans:

- a) Production of thin shoots and frequent formation of banjhis,
- b) Reduction of crop productivity and quality- stagnation,
- c) Poor response to fertilizer inputs.
- d) Burns up root reserves, feeder roots degenerate,
- e) Poor recovery after pruning, dieback of new sprouts,

(Ref: Manivel L. 2011, past, present and future of the Indian tea industry, Concourse , p 76)

Q. How to correct soil pH below 4.5?

A: If the soil P^H is below 4.5, dolomite (60-80 mesh sieves or finer 180 – 250 micron) should be applied @ 2tonnes/ha in dry winter months and lightly **incorporated into the soil** by forking 6 -8 weeks prior to normal application of fertilizers. For best results the soil should be moist. Therefore in case of dry soil a light irrigation prior to dolomite application will help incorporation and hasten the reaction.

(Ref: Singh Bhupal, 2009. Soil Properties Affecting Irrigation & Drainage System Design, Soil and Water Management, p 10-21)

Q: When to apply Dolomite?

Ans:

a) Pruned sections should be considered for dolomite application. Sending of soil samples to TRA is **required** to know soil pH prior to dolomite application.

b) Dolomite should be broadcast following **light pruning when the leaves of the pruning litters are dried up (say after about a month)**. Pruning litters should be kept either on the tea bushes or accumulated in the alternate tea rows prior to broadcast.

(Ref: Notes on Field Management, 2002, p 120)

Q: How to correct soil pH above 5.5?

A: To lower soil pH below 5.5 apply iron pyrites or aluminium sulphate @ 2 tons/ha. After application allow 15 days time for oxidation and then fork into the soil. It is also necessary to provide deep drains to cut off subsurface seepage flow from adjacent high land. **(Ref: Notes on Field Management in Tea 2002, p 120)**

Q: Whether storage of soil samples affects the soil test values?

A: Storage for unusually long period does affect soil test values, especially pH and available potash values. Available phosphate and organic carbon values should not be influenced perceptibly due to storage. **(Ref: Dr. B.C.Barbara's correspondence with Mr. S.K.Dey,)**

Tea Nursery

Q: What should be the chemical suitability (soil pH) of soil for the success of V.P. Nursery?

A: pH between 4.5 and 5.2 is ideal. In case of high pH Aluminium sulphate should be applied as follows:

Range of soil pH	Aluminium sulphate solution	Aluminium sulphate solid
5.5-5.8	5% (60 ml solution/sleeve)	4g/sleeve
5.8-6.2	8% (- do-)	5g/sleeve

(Ref: Quarterly Advisory Bulletin, April- June 1988, North Bank)

Q: Why unpruned bushes are not recommended to make mother bushes for taking cuttings?

Ans:

- a) Cuttings taken from unpruned bushes are inferior in strike to those taken from pruned bushes.
- b) Unpruned mother bushes pass over to the reproductive phase from vegetative phase. Cuttings taken from shoots where flower initials have already formed do not root readily nor do they produce vigorous plants.
- c) Mother bushes are therefore pruned at intervals to keep it in a vegetative state.

(Ref: Science and Practice of Tea Culture by D. N. Barua, 2008, p 271)

Q: Is there any benefit by reducing the leaf area of a single leaf cutting?

A: Reduction of leaf area of single leaf cuttings does not usually improve success appreciably unless the leaf happens to be very large. In large leaves each having an area of more than 80 sq cm, Bezbaruah (1977) observed better strike by cutting off the tip and reducing the area keeping 80 sq.cm leaf area.

(Ref: Science and Practice of Tea Culture by D. N. Barua, 2008, p 272)

Q: Is there any difference in success rate of cuttings among the position of the leaves in a newly grown primary of a pruned bush?

Ans:

- a) Top three leaves of a growing primary were found unsuitable for propagation. But 4th, 5th and 6th positions of leaf were found to develop good rooting.
- b) In primaries where apical bud has gone banji even the second leaf was found to develop good roots.

(Ref: Science and Practice of Tea Culture by D. N. Barua, 2008, p 273)

Q. How many polyethylene sleeves will make one kg when the size of the sleeve is 15 cm lay flat and 22 cm in length having 150 gauge thickness?

A: 300 sleeves (approx) will make one kg.

(Source: Notes on Field Management, p59)

Q. How much soil will be required for filling up 28,000 sleeves of size 15cm lay flat and 22.5 cm (6 inches x 9 inches) in length?

A: 180 cft of soil. **(Source: Notes on field management 2002, p 59)**

Q. How much Single super phosphate should be mixed with the soil before filling up the sleeves for planting cuttings.?

A: 500 g Single Super Phosphate (SSP) should be added with the one cubic meter of chemically tested soil before filling up the sleeves.

(Source: Notes on field management, p 56)

Q: How many cuttings should be planted in the nursery to transplant one hectare area?

Ans:

- a) Plant population requirement for a hectare will depend on spacing. In general we plant tea at a spacing of 105 cm x 60 cm (single hedge). In this spacing plant population per hectare will be 15,873 as per calculation.
- b) But actual plant population per hectare will be about 6% less than the calculated plant population (15,873) due to paths, shade trees and drains inside the section. So approximately it comes to about 14,921 plants/ha.
- c) A clone is released by TRA whose success rate is more than 75%. Taking 80% success rate (good plants) we will need to plant 20,000 cuttings to get about 16,000 plantable plants to plant one hectare area.
- d) Some plants will be kept in the nursery for infilling in case any mortality takes place or some plants may be damaged due to improper handling during the transit.

Q: How to prepare a cutting for vegetative propagation?

Ans:

- a) Cuttings should be prepared from a healthy primary of a pruned or DS mother bush.
- b) A good cutting have a fully mature healthy undamaged leaf with a dormant or slightly swelling bud and a hard green stem of about 3 cm in length below the leaf petiole and about 0.5 cm above the leaf.
- c) The top cut of the cutting should be made immediately above the axillary bud parallel to the leaf blade. The basal cut of the stem should be given obliquely more or less parallel to the top cut.

(Ref: Notes on Field Management in Tea, 2002, p 56)

Q: How all the plants raised by vegetative propagation bear similar characters morphologically and genetically?

Ans:

- a) Initiation of adventitious roots takes place at the basal cut end from the cambium layer of the cuttings through a process of asexual cell division called Mitosis.
- b) In Mitosis the newly divided daughter cells also contain the same number of genes in their chromosomes. Therefore all the plants raised from vegetative propagation bear similar characters of the mother bush (morphologically and genetically).

(Ref: Phukan B.C. 2002, Vegetative propagation in tea, Notes on Field Management in tea, p 55)

Harvesting of tea crop

Q: What is the meaning of the term flush?

A: The term 'flush' has been applied to the amount of growth produced by the terminal bud between two states of temporary dormancy (banji stage).

Q: How many flushes take place in a tea bush in N.E. India?

A: Five flushes take place in a tea bush.

Q: Can you name the flush periods?

A: The flush periods are as follows:

1st Flush:	January - mid April	= 105 days (near Equator)
	March – mid April	= 46 days (in N.E. India)
2nd flush:	Mid April- end June	=76 “
3rd flush:	July – September	= 92 “
4th flush:	Oct – Mid Nov	= 46 “
5th flush:	Mid Nov- end Dec	= 46 “

(Source : TRA)

Q: What is banji period?

A: The temporary resting period between the two flushes is called a banji period.

(Source: Science and Practice in Tea Culture, 2008, p 81)

Q: What is growth cycle?

A: One each of a flush and banji period together comprises the Growth cycle.

(Ref: Notes on Field Management in Tea, 2002, p 38)

Q: What is leaf period?

A: Leaf period in tea is the duration between unfolding of two successive appendages (leaves) on a growing shoot. The rate of leaf unfolding varies from clone to clone and from season to season. Shorter day length coupled with low temperature increases the period of leaf unfolding. (Ref: Notes on Field Management in Tea, 2002, p 38)

Q: What is the difference between inter-flush dormancy and winter dormancy?

Ans:

- When temporary dormancy takes place between two flushes of growth in tea it is called inter-flush dormancy (i.e. banji stage) in tea. This temporary dormancy takes place due to the constriction of xylem vessels at the growing point reducing the proper supply of water and nutrients to the growing point.
- But winter dormancy takes place when day length becomes less than 11 h 15 m and minimum ambient temperature drops below 12°C tea bushes become dormant.
- During this period of dormancy abscisic acid (a growth retarding hormone) increases rapidly as compared to growth promoting hormones (GA₃ and IAA). The increased composition of abscisic acid keeps the bud in dormant condition till day length increases.

(Ref: Notes on Field Management in Tea, 2002, p 38-39)

Q: What is meant by Leaf Area Index (LAI)?**Ans:**

- a) The size of the maintenance leaf canopy of a tea bush is expressed in terms of Leaf Area Index (LAI). It is the ratio of total leaf area of a bush to the ground area allocated to the bush.
- b) A stand of tea will have an average LAI of 5 if the total area of its maintenance foliage is 5 times the area of the plot of land on which it grows.

(Ref: Science & Practice of Tea Culture 1989 by D.N. Barua, p 385)

Q: What is meant by Harvest Index (HI)?**A:**

- a) The percentage of dry matter of shoots harvested in tea in relation to gross weight of the entire plant is called **Harvest Index**.
- b) The Harvest Index of tea in N.E. India varies **between 9 and 12 %**.
- c) Distribution of net weight and respiratory loss in different organs of tea pruned annually is given below:

Particulars	Plucking	Pruning	Frame	Root	Whole bush
Net wt as % of gross wt.	10.6 (HI)	17.6	4.9	3.1	36.2
Respiratory loss (%)	3.2	57.3	2.2	1.1	63.8
Total	13.8	74.9	7.1	4.2	100.0

Thus only 36% of the total carbohydrates produced by a tea bush go to its different organs and the remaining 64% is lost through respiration.

(Ref: Barman T.S. & Konwar B.K (2002): Physiology of growth and productivity of tea, Notes on Field Management, 35-47)

Q: What is meant by Dormancy Index?**Ans:**

- a) The dormancy index is a measure of the length of the terminal bud in relation to the length of the topmost leaf of a shoot.
- b) In practice, the number of plucked shoots are divided into two lots; those in which terminal buds are less than half the length of the topmost leaf and those where it is more than half of the topmost leaf. The number of former (less than half) divided by the latter gives the dormancy index.
- c) A high ratio will indicate that the buds are nearer to the state of dormancy while a lower ratio will indicate the reverse (dormancy is yet to come).

(Ref: Barua D.N. 1989: Growth Characteristics of the tea plant, Science and Practice of Tea Culture, P 76)

Q. When the starch reserve in the roots of young plants can be found adequate?**Ans:**

Adequate reserve of starch can usually be found in N.E India during peak winter months (between December and early February) when the tea plants remain dormant.

(Ref: Chakaravartee J and Barbara A.C. (1997): A few aspects of pruning, Field Management in Tea, p 62)

Q: What should be the procedure of starch test before young tea pruning?

A:

- a) A hole of about 10-15 cm deep should be dug around 10 cm away from the collar of the young tea plant and sever any red root about a wood pencil thickness (6 mm thick).
- b) A transverse cut to the root is to be given with a very sharp knife weighing about 500 g placing the root on a thick wooden piece.
- c) A drop or two iodine solution should be applied to the smoothly cut surface of the piece of root by holding it upright. The root is to be kept in that position for about 5 minutes after which the iodine solution is shaken off and the change of colour is to be noted.
- d) If the starch content is very low pale coloration will develop, and in the absence of starch, there will be no change in colour. In this situation pruning is to be deferred by resting the bushes for some time.
- e) When there is adequate starch reserve, deep blue coloration will be developed similar to that freshly cut piece of potato when smeared with the same iodine solution. In this situation the bush can be pruned.

(Source: Tea Culture by D.N.Barua, p.336-337)

Q. How many bushes should be considered for starch test in a section?

A: Representative sample of bushes should be 1 in 1000 bushes.

(Ref: Tea Encyclopedia Serial No. 197/1 p2, Filed under G. I)

Q. Is it true that stems also contain starch?

A: Yes. red roots act as a main starch reserve. Thicker roots reserve more starch than thinner roots. Stems having the girth of 0.25, 0.50, 0.75 and 1.00 cm diameter also contain fair amount of starch.

(Ref: Barman T.S., Saikia J.K and Pathak S.K 1998, Two and a Bud, 45 (1), 14-18)

Q: How deep thicker tea roots (red roots) of tea bushes under plucking can go inside the soil profile?

A:

- a) Depth of thicker tea roots more than 5 meters has been reported from Central Africa (Fordham 1972) and up to 4 -5 meters in Tanzania (Carr 1971).
- b) In the plains of N.E. India presence of high water table restricts where thicker roots of plucked bushes seldom penetrate beyond a depth of 2 meters.

(Ref: Barua D.N 1989: Growth characteristic of tea plant, Science and Practice of Tea Culture, p 99)

Q: Where maximum quantity of feeder roots of tea bushes generally found in the soil profile?

A:

- a) Young roots of tea plants are called white roots and with age they start to change their colour to creamy and then to red. The white roots are called feeder roots as they absorb nutrients from soil and supply to the different parts of the tea plants.

- b) The quantity of feeder roots decreases with depth and that about two thirds of the feeder roots are found to confine themselves to the depth of 30 cm to 40 cm in the soil profile from the ground level.
- c) The thickness of these feeder roots varies between 0.3 to 3.0 mm.
(Ref: Barua D.N 1989: Growth characteristic of tea plant, Science and Practice of Tea Culture, p 81 & 97)

Q: What the term 'effective root depth' indicates?

A: The term effective root depth indicates the depth beyond which only a very small fraction of root penetrates. Effective root depth of mature tea (seedling and clone) is as follows:

Seed grown bushes: 68 cm (approx),

Clone : 57 cm (approx),

(Ref: Annual Scientific Report 1963, p 31)

Q: What is the meaning of stub?

A: Basal portions of the shoots left behind on the tea bush after harvesting of apical

Portions (two leaves and a bud) are known as stubs (Barua D.N. 1989)

(Ref: Science & Practice of Tea Culture, 1989, p 381)

Q: What is meant by source and sink?

Ans :

- a) The canopy of maintenance foliage of a tea bush is the 'source' of carbohydrates (food) produced by photosynthesis and the proliferating and expanding organs of the plant are the sinks (i.e. shoots). The product of photosynthesis move from source to sink (i.e. from maintenance foliage to shoots).
- b) Sink capacity can be increased by shorter rounds of plucking.

(Ref: Science & Practice of Tea Culture, Barua D. N. 1989, p 384)

Q: At what ambient temperature the extension growth of the tea plant ceases?

Ans:

- a) The extension growth of the tea plant ceases below a minimum temperature of 13°C.
- b) While extension growth stops at about 13°C but photosynthesis in N E India was observed to continue in the month of December when the mean minimum temperature was lower than 13°C and the tea bushes were completely dormant (Manivel 1980). (Ref: Science & Practice of Tea Culture by D.N.Barua, 1989, p 416-417).

Q: Can photosynthate (carbohydrate) move from one mature leaf to another mature Leaf ?

A:

- a) The movement of photosynthate from the maintenance foliage is decided by the growing shoots. When shoots grow, photosynthate moves upward but in case of dormant shoots (banji shoots) it moves downward.
- b) But photosynthate cannot move from one mature leaf to another mature leaf.

(Ref: Barman T.S. & Konwar B.K (2002): Physiology of growth and productivity of tea, Notes on Field Management, 35-47)

Q: How crowsfeets are formed?

A: When a shoot is plucked new laterals (branches) grow out just below the plucking level. They are plucked in turn and the resulting bunches of short thin branches left are known as **crowsfeets**.

Categorization of planting materials & identification mark of TV 22 & TV 23

Q: Which are the high yielding clones and seed stocks?

A : Planting materials having high yield potentiality but average quality are called **Yield clones** and **Yield seed stocks** respectively.

Yield Clones: TV 9, TV 18, TV 19, TV 22, TV 23, TV 25, TV 26, TV 29, TV 30.

Yield Seed Stock: TS 462, TS 463, and TS 506.

Q: Which are the quality clones and quality seed stocks?

A: Planting materials having high quality but average yield are called quality clones and quality Seed Stocks.

Quality Clones: P 126A, N436, S₃A₃, S₃A₁, T₃E₃,

Quality seed stocks: TS 491 (TV 1 X S₃A₁)

Q: Which are the combination of both (we call standard planting materials)?

A: Clones and biclinal seed stocks having above average yield and quality are called **Standard Clones**.

Standard clones: TV1, TV 14, TV 16, TV 17, TV 20, TV 31, Teenali 17/1/54.

Standard seed stocks: TS 449, TS 464, TS 520 (TV 19 X TV 20),

Q: What are the clones and seed stocks should be planted on tillas of Cachar?

A: Hot slope: TV 22, TV 23, TV 25, TV 26, TS 462, TS 463, (priority TV 22 & TV 23),

Cold slope: All standard clones and seed stocks can be planted.

Q: Seeds or clones what is preferred for Tillas?

A: Seeds are always better as they have elasticity. But we do not have any hardy seed stock.

Q : How to identify TV 22 and TV 23?

A: Apparently there is no difference but if you count the number of serrations of one side of the leaf you will find the difference in the number of serrations of the clones. TV 23 is having more serration (65-67) than TV 22 (57- 59).

(Ref: Barman T. S, Bordolai R. K., Saikia J.K., Das B (2013): Importance of tea leaf serration, Two and a Bud, 60 (2) p 53-54)

Q: What is the reason for yellowing of tea leaves of TV 22 and TV23 during autumn?

Ans:

- a) Yellowing of leaves will gradually start from the month of August. It will become again green at the beginning of the next growing season.
- b) This is called autumn pigmentation. This is a genetical character.

- c) During this condition chlorophylls (green pigmentation of the leaves) get masked due to physiological process during this time of the year. But growth process continues.

Q: Why yellowing of the leaves of the tea bushes is sometimes noticed on the drain side tea bushes?

Ans:

- a) When excavated soil from the drains during drain cleaning or drain deepening is dumped near the collar region of the tea bushes creating a situation like deep planting.
- b) Due to deep planting like situation disruption in the movement of photosynthes from leaves to roots through phloem vessels for storing cannot take place as a result disturbance in the physiological process takes place which causes yellowing of leaves.
- c) Only way to get rid of this malady is to remove the soils from drain side by flattening the drain sides.

Rehabilitation crops and green crops:

Q: What are the recommended rehabilitation crops?

A: They are: **Guatemala grass** (*Tripsacum laxum*), **Pusa Giant Hybrid napier Grass** (*Pennisetum purpureum*), (Ref: Tea Encyclopaedia Serial No. 178/1 Filed under E2)
Citronella grass (*Cymbopogon nardus*)

Q: What are the recommended green crops for young tea areas?

A : Green crops are generally used as a temporary shade for newly planted teas. I quote below the names of recommended green crops and number of seeds per kg against each name:

Name of the green crop	No. of seeds/ kg	Usefulness
@ <i>Crotalaria anagyroides</i> ,	40,300	adds 500 quintels OM/ha
* <i>Prionotropis cytisoides</i> ,	64,600	green manuring plants
* <i>Desmodium gyroides</i> ,	20,400	-do-
* <i>Teprosia candida</i> ,	61,200	- do-
OM: Organic matter, @: Susceptible to: <i>Fusarium</i> & Black rot, * Black rot & Red rust		

Q: Please tell us the names of some of the cover crop?

A: I quote below the names of cover crop and the number of seeds /kg of each crop:

Name of the cover crop	No. of seeds/kg	Usefulness
<i>Mimosa invisa</i> :	3,01,000	cover crop (300 qtls/ha)
<i>Calopogonium mucunoides</i> :	75,000	-do- (200 qtls OM/ha)
<i>Centrosema pubescens</i> :	-	-do- (400 qtls OM/ha)
<i>Stylosanthes guianensis</i> :	-	-do- (50 tons GM/acre)

(TRA Memorandum 30, p 3)

Q. What will be the requirement of seeds of *Crotalaria anagyroides* per hectare when planted in every inter row spaces in young tea (0 yr, + 1 yr)?

A: 10- 12 kg/ha. (Source: Tea Confidential by Jagot Chakravortee, p 77)

Q. How many seeds of *Crotalaria anagyroides* will make one kg?

A: 40,300 *Crotalaria* seeds (average). (Source: Memorandum 30, p 82)

Q. What will be the requirement of number of Guatemala cuttings per hectare (flat areas) when planted at a spacing of 60 cm x 60 cm?

A: 27,777 cuttings/ ha (but requirement of cuttings will be about 4- 5% less than the calculated number of cuttings due to the location of the drains, etc). Actual requirement will be 26,666 cuttings. (Ref: Tea Encyclopedia Serial No. 178/1, 2 sheets, filed under E 2)

Q: Can you tell us how deep the root system of Guatemala grass can go and also the depth of roots of Citronella grass?

A: The Guatemala grass had a robust, proliferated and deeper root system down to a depth of 120 cm (4 feet) whereas Citronella grass had a sparse root system extending only to a depth of 80 cm (2 feet 8 inches) from the ground level.

(Ref: Goswami,H. 1992: Effect of Rehabilitation crops on Soil Physical Properties, Two and a Bud, 39, 1, p 16-19)

Q. What will be the requirement of seeds of Mimosa invisa (brown seeds) per hectare when sown in rows at 1 meter apart?

A: 4-5 kg/ ha. (Source: Tea Confidential by Jagot Chakravortee, p 308)

Q. How many seeds of Mimosa invisa will make one kg?

A: 3, 01,000 seeds/kg (Source: TRA Memorandum 30, p. 114)

Q: What is the difference between Mimosa invisa and Mimosa pudica?

A: Mimosa invisa is thorn-less and Mimosa pudica is thorny.

(Ref: TRA Memorandum 30, p 114)

Shade

Q: How many seeds will make one kg each of recommended shade trees and their leafless period?

Ans:

Name of the shade trees	No. of seeds/kg (approx)	*Leafless period
Albizzia chinensis	30,000	end Jan to end Mar
Albizzia odoratissima	20,000	end Dec to end Feb
Albizzia lebbek	8000	Jan to April
Albizzia procera	30,000	Feb to May
Derris robusta	35,000	mid Dec to Feb
Acacia lenticularis	20,000	Mar to April
Dalbergia sericea	50,000	Dec to Mar
Adenanthera pavonina		Jan to Mar
Al. luciada	20,000	Mar to April

(Source: The Planters' handbook, p 47), (Source: * Memorandum : 30),

Q: What should be the height of the selected saplings of recommended shade trees at the time of transplanting ?

A: Between 150 cm (5 feet) and 180 cm (6 feet).

(Source: Field Management in tea, 2005, p 147)

Q. How many days before transplanting we should cut the top of the selected saplings of shade trees in the nursery to reduce transpiration loss?

Ans:

- 7 days before transplanting. The top of the selected saplings should be cut **on thick wood** (removing the green part) in the nursery itself at a height between 150 cm and 180 cm from the ground.
- The cut should be covered with a lump of mixture of raw cow dung and wet soil to seal the cut end immediately and cover the mixture by tying with a piece of jute cloth/ polyethylene. (Source: Field Management in Tea, 2005, p 147)

Q: If it would be appropriate to use the same factor 0.225 for converting green leaf of shaded sections and unshaded sections as green leaf of shaded sections contains more water than unshaded or poorly shaded sections?

A: TRA recommends a conversion factor of 0.214 for green leaf of shaded section for converting to made tea and 0.225 is for unshaded or poorly shaded section.

Logic behind this observation:

Even if the increase in yield due to shade is real, there is a disproportionate increase in the amount of water. Hence a correction is necessary for assessing the requirement of a factory to deal with the excess quantity of water in shoots from shade grown bushes. So green leaf from shaded section should be multiply by 0.214 and unshaded or poorly shaded section by 0.225. (Ref: Annual Scientific Report, 1957, p 39)

Q What will happen if we plant shade trees at closure spacing than the recommended?

Ans:

Shade trees at optimum spacing interrupt the direct sun-rays and provide adequate light i.e. 50-70% of the total sunlight. Thereby photosynthetic rate is enhanced by about 24% compared to fully exposed leaves to sunlight. However over shading is also detrimental for optimum growth. I quote below TRA's findings to explain the demerits of closure spacing:

% sunlight falling on tea bushes	Chlorophyll		Pn	Ass %	Soil moisture %	Plucking point density (No/m ²)
	a	b				
100	1.24	0.66	68	27	11	95
70	1.50	0.70	156	43	12	129
50	1.82	0.96	106	39	14	126
30	2.09	1.01	43	26	14	49

Photosynthesis : Pn, Partitioning of assimilates : ASS,

From the above table it can be inferred that closure spacing can only increase Chlorophyll a but cannot increase assimilates, soil moisture and plucking point density

(Ref: Sarma A.K, 2006, Physiological Behaviour Of The Tea Plant, Field Management in tea, p 31).

Q: Is it true that the value of tea made from shoots produced under moderate shade is slightly lower than the tea made from unshade bushes?

A: Yes, I quote below the observation made by Dr. D. N. Barua:

"Despite some loss of value, monetary gain from moderately shaded tea under North East Indian conditions was shown to be much higher than from tea without shade, because increase in yield more than compensated for the slight loss of value of the made tea." (Ref: Barua D.N. 1989, Science and Practice in tea culture, p 432).

Q: What are the nutrients we get from shade tree litters per hectare annually?

A: The latest estimate of the shade tree litters from a stand of Al. chinensis trees casting moderate shade (50-60% light intensity) adds annually 2500-5000 kg dry matter per hectare . Contribution of nutrients from these dry matters per hectare is N- 63 to 126 kg , P₂O₅- 18 to 36 kg, K₂O- 22 to 44 kg, Cao 32 to 64 kg, Mgo 16 to 32 kg .

(Ref: Two & A Bud, December 1976, p 68)

Q: How rotational use of shade trees can be undertaken?

Ans:

- Rotational planting of shade trees means removing old shade trees and planting of new line of shade trees.
- After about 25 years shade trees start dying from top due to pest infestation and become difficult to spray insecticide for looper control due to their height. Their demand for nutrition and water requirement also increases.
- Inter-planting of saplings of permanent species of shade trees should be considered for planting (stump planting) 5 years prior to removal of old shade trees.
- Prior to removal old shade trees **ring barking** of these shade trees should be undertaken at least 2 years before to exhaust the accumulated starch in their roots. This procedure of killing shade trees is required as a precautionary measure to stop spreading of root diseases to tea from the left over shade tree roots in the soil.

Q: TRA recommends rotational planting of shade trees. What is the meaning of rotational use of shade trees?

Ans:

- a) Rotational planting of shade trees by removing old shade trees is recommended as life of our recommended permanent shade trees is 25 years.
 - b) After about 25 years they start dying from top due to pest infestation and it becomes difficult to spray insecticide for pest control due to their height.
 - c) Their demand for nutrition and water requirement also increases and tea bushes below shade trees start wilting during the period of drought.
- (Ref: Field Management in tea),

Q: what is the procedure for rotational planting of shade trees?

Ans:

- a) Inter-planting of saplings of permanent species of shade trees should be considered for planting (stump planting) 5 years ahead of the removal of old shade trees.
 - b) Prior to removal old shade trees ring barking of these shade trees should be undertaken at least 2 years before to exhaust the accumulated starch in their roots. This procedure of killing shade trees is required as a precautionary measure to stop spreading of root diseases to tea from the left over shade tree roots in the soil.
- (Ref: Field Management in tea),

Pruning & Skiffing

Q: What are the reasons for pruning?

Ans:

- a) To check reproductive growth and provide stimulus for vegetative growth,
- b) To correct past defects in bush architecture,
- c) To control frame height and maintain a flat plucking table for economic plucking,
- d) To regulate crop,
- e) To facilitate consolidation by infilling of vacancies.

(Ref: Phukan B.C: Notes on Field Management , p 67)

Q: What should be the right time of pruning and skiffing of mature tea and FFP of young tea?

Ans

- a) RP, MP & HRP : Between early December and end December (after rest for 6 – 8 weeks from mid October).
- b) LP : : Between early December and end December,
- c) DS: : Between mid December and early January,
- d) MS: :Between early January and mid January,
- e) LOS (UP) :Between end December and early January,
- f) Hand leveling :Between end January and early February,
- g) FFP : Between mid January and mid February,

Q: Is there any recommendation on the length of the stub (length of pruning wood) to be left in case of old tea, mature tea and young tea?

Ans:

- a) The younger is the wood longer is the intermodal length. Hence longer wood is necessary to retain one or two dormant buds to sprout in the growth of the new primaries.
- b) Minimum one bud is ok on the stub of the mature bushes. So length of the stub to be left is as given below:

Old tea = 3 cm

Mature tea = 4 cm

Young tea and youngish mature tea = 5 cm

(Source: Tea Confidential, 2017, by Jogat Chakravortee, p 106)

Q. How much new wood should be left on the pruning table at the time of first LP after MP/HRP/KRP (Medium Prune/Height Reduction Prune/Knot Removal Pruning)?

A: The length of new wood should be approximately 7.00 cm (2 ½ inches) on the pruning table at the time of first LP after heavy prune.

(Ref: Tea Encyclopedia Serial No. 53/5 filed under G 1, p 2)

Q. If LP is delayed beyond mid January what will be the impact on crop?

A: It is evident from the regional experiments of TRA, Tocklai that the best time of light

pruning is between December and January to the plains of N. E. India. Experiments revealed that if light pruning is delayed and done in February there will be about 6% loss of crop in the year of light prune.

(Source: Notes on Field management in tea of TRA, 2002, p 69)

Q: What is the ideal time to remove breathers which were left on the bushes at the time of LP?

A: Ideal time of removing the breathers from the bushes in droughty areas without irrigation should be when some of the shoots on the frame of the bushes have unfolded three leaves.

In non-droughty areas or in droughty areas with irrigation facility breathers can be removed when about 10- 15% buds start growing on the frame.

(Ref: Tea Encyclopaedia Serial No. 53/5, filed under G 1, P 3, Revised May 1992).

Q: What are the possible causes of knot formation on frame of a tea bush?

A: Possible causes of knot formation on a tea bush are:

- a) Low tipping following LP
- b) Low DS (leaving **less than** 12.5 cm of DS wood)
- c) Lack of keeping adequate length of new wood (4-5 cm) from the last LP mark at the time of pruning.

(Ref: Barbara B. C. & Banerjee M.K. (1988): Causes and Prevention of knot formation in tea, Two and A Bud, Vol.35,(1 & 2), p 39-42)

Q: Die back of plucking points take place of the tea bushes under plucking during drought. Should we remove the die back portion by skiffing?

Ans:

- a) Die back portion should not be removed by skiffing.
- b) Shoots will grow from below the dieback portion and when they come above the plucking table they should be plucked.
- c) Skiffing during drought will lead to **further die back** because of the moisture loss from the cuts made by skiffing.

Q: How to accelerate decaying of pruning litters?

A: Decaying of pruning litters can be accelerated by using one kg Nitrogen in 100 kg of pruning litters (i.e. 1: 100).

Q: What will be the loss of crop if we remove the pruning litters from the section?

A: The removal of pruning litters from a section causes loss of crop to the extent of about 10.5% (approx) (**Ref: Two & A Bud December 1961, p 7).**

Replanting of tea

Q. What should be the minimum spacing of planting of tea in tillas of Cachar district of Assam?

A:

- a) 100 cm x 65 cm spacing (15,384 plants/ha, calculated) will be convenient in Cachar tillas for plucking instead of 90 cm x 60 cm (18,518 plants/ha).
- b) This spacing will help to increase pluckers' productivity.

(Ref: Tea Confidential, 2017 by Jogot Chakravortee, p 75)

Q. What will be the actual bush population per hectare at spacing of 100 cm x 65 cm?

A. Actual bush population will be about 5% less than calculated (15,384 plants/ha) because of drains, paths and shade trees (i.e. 14, 615 plants/ha).

This plant population is in line of TRA's recommendation (14,000 – 15,000 plants/ha).

(Ref: Tea Confidential, 2017, by Jogot Chakravortee, p 161)

Q. What can be used in the planting pit at the time of planting in absence of cattle manure / vermicompost?

Ans: Any one as mentioned below can be used:

- a) Vikas Khol (Godrej) @ 1 ton/ha at the time of land preparation, and 150 g/pit at the time of planting.
- b) Oil Cake 300 g/pit, should be soaked with water one day prior to using in the planting pit (Ref: Tea Confidential by Jagot Chakravortee, p 74)

Q: What quantity of soil loss takes place when inter-row mulching is undertaken with different mulching materials following replanting of tea ?

A: I quote below the findings of TRI, Sri Lanka as highlight by Mr. S K.Dey in 1985:

Effect of mulching & cover crop on soil loss (mt/ha)

Treatment	Year after planting tea				
	1st	2nd	3rd	4th	Total
Bare(without mulch)	88.68	51.37	1.78	1.29	143.12
Guatemala grass mulch	7.00	1.27	1.38	1.18	10.83
Mana grass mulch	5.10	2.20	0.88	1.32	9.50
Crotolaria mulch	31.78	4.72	1.48	0.92	38.90
Weeds	27.58	2.48	1.80	1.95	33.81
Eragrostis (cover crop)	11.12	1.80	0.88	0.98	14.78

In general mulching was found to be the most effective means of reducing soil erosion during the early period of 2 years from planting.

(Ref: Lecture Course on Field Management in tea, 1985, Soil & Fertilizer Management by S.K. Dey, p 5-6)

Q: What will be the requirement of mulching young tea with Guatemala grass initially?

A:

- a) Initially one hectare of Guatemala grass will be necessary for heavy mulching after transplanting one hectare of tea. But for subsequent mulching for next 2 to 3 years one hectare of grass will suffice for four hectare of tea.
- b) 15 t/ha fresh vegetative matter is required for 3 inches thick mulching.

(Ref: S K Dey's letter 0026/S69/404 dt 13/01/1969 to Chraideopurbat T.E)

Organic manure

Q: Tell us the importance of organic matter?

A:

- a) Store house of nutrients,
- b) Abode of micro-organisms,
- c) Influence formation of aggregates,
- d) Retention of soil moisture,

Q. What should be the pH value of the vermicompost?

A: Generally pH value of the vermin-compost remains close to neutral (between 6.76 and 7.28). **(Source: Field Management in tea, 2006, p177)**

Q. Tell us the percentage of major nutrients (approximate) in vermicompost ?

A:

- a) Vermicompost contains about 1.2-1.78% N, P_2O_5 0.75-1.12% and K_2O 0.65-1.14% and S (sulphur) 0.24-0.52%.
- b) Besides these vermicompost also contains Lead (8-18 ppm), Zinc (40-72 ppm) and Cadmium (0.10-0.18 ppm) **(Ref: Quoted from Field Management in tea, 2006, p177).**

Q: What will be the quantity of organic matter and contents of nutrients generally found in horse dung?

A: Organic matter 18%, nitrogen 1.5%, potassium 0.8% and phosphorus 3.2%.
(Ref: Analysis done by Hindusthan Fertilizer Corporation Ltd., Siliguri, Letter no.FP & ARD/STL/SLG dt. 31.07. 1995)

Q: How much vegetative materials will be required to provide 2.5 cm (one inch) thick mulch to cover one hectare area ?

A: About 5,000 kg green vegetative matter will be required to provide 2.5 cm thick mulch per hectare of young tea. Mulching helps to conserve soil moisture.
(Ref: Organic matter management in tea estate by A.C.Barbara, Two and a Bud 42(2) 1995, p 8-12).

Q: Can mulching with vegetative matter increase the production of feeder roots of tea plants?

A: Mulching was clearly found to be very effective in increasing the production of feeder roots of upper soil horizon. **(B.C. Barbara,1970, Two and A Bud, vol.17, No.4,p 71)**

Q: What will be the ideal time of mulching to conserve soil moisture with vegetative matters(loppings of Guatemala, Napier grass, Mimosa invisa are ideal but materials like Eupatorium, Ageratum, Tora pat and thatch type of grass can also be used) ?

A: Sufficient moisture is stored in the soil profile after the monsoon rain ceases in September- October. So ideal time for mulching for conserving soil moisture is between October and mid November. Mulch materials should be kept about 10 cm away from the collar region of young plant to avoid heat damage. **(Ref: B.C. Barbara, 1970, Two and A Bud, vol.17, No.4, p 71)**

Q: If Mikania can be used in the preparation of vermicompost?

A: a) Yes. Leachate derived from vermicompost often called vermiwash. This vermiwash could be utilized as foliar spray.

a) Vermiwash prepared from Mikania contains highest amount of potash.

b) Foliar application of vermiwash (5-10%) has been found to be effective on the growth and productivity of young and unpruned mature tea.

(Ref: Vermiwash- An effective organic nutrient amendment for foliar spraying in Tea Cultivation by Ishan kr. Phukan & D. Savapondit, Science and Culture, 2011, vol. 77, No. 9-10, p 425

Q: What will be the weight of 1 cft dry cow dung in kg?

A: 2 to 2 ½ kg?

Plant Protection

Q. What should be the gap between spraying of Copper fungicide and plucking?

A:

- a) Food and Drugs Acts of the principal importing countries of tea permits a maximum limit of 150 ppm of Copper in made tea.
- b) However application of Copper fungicide must be made at the earliest opportunity after plucking and on no account should application be made less than five days before plucking which would give four clear days interval before plucking. (This point must be noted for Darjeeling gardens where controlling blister blight is a problem).

(Ref: Quoted from ' A guide to Protection of Ceylon Tea from Blister Blight 1955- Pamphlet No. 2 of Tea Research Institute of Ceylon).

Q. What are the damage symptoms of mites (Red spider, Scarlet mite, Pink mite and Purple mites) appear on tea leaves?

Ans.

- a) Red spider : Attacks upper side of mature leaves turning the leaves coppery brown,
- b) Scarlet mite : Attacks the undersurface along the mid-rib of the young leaves and the base of the petioles and young stems.
- c) Pink mite : Attacks both surfaces of young leaves but they colonise on young tender leaves of the top shoots.
- d) Purple mite : Attacks both the surfaces of mature leaves but more prevalent on the upper surface. **(Ref: TRA Memorandum 27, p 169- 194)**

Q. How to recognize mites (Red spider, Scarlet, Pink and Purple mite)?

Ans.

A 10X magnifying hand lens is essentials to recognize above mentioned mites as follows:

- a) Red spider : Bright red, oval,
- b) Scarlet mite : Deep orange to purple, oval,
- c) Pink mite : Light Orange, Carrot shape,
- d) Purple mite : Dark purple with white strips,

(Ref: Planters' Handbook, 1996, p 60)

Q. What are the early symptoms of damages of caterpillar pests ?

Ans.

a) Looper caterpillar:

Young caterpillar is dark brown and with age it acquires a brownish tinge and ultimately attains a brownish grey colour similar to that of the mature twig of a tea bush. Young ones make holes along the margin of young leaves and then bite off small pieces at the margins.

b) Red slug caterpillar:

Colour brick red, attack the mature leaves of bottom hamper and feed on the tissues of undersurface of the leaves in an irregular circle leaving the membranes of the leaves intact. In absence of mature leaves, they might attack the bark of one or two year old stems of pruned or deep skiffed teas.

a) **Bunch caterpillars:**

Bright coloured caterpillars remain congregated on the branches of the tea bushes in clusters during the day time. The branches on which they form clusters are completely stripped off their leaves as a result defoliated bushes in isolated patches are noticed.

b) **Nettle grub:**

In early stage the larvae feed on tissues of leaves in patches on the undersurface of the leaves in a longitudinal design, leaving the upper epidermal membrane intact.

c) **Lobster caterpillar:**

It eats away all the leaves of the branch on which it is present and then moves to another branch. 5 to 10 caterpillars can completely defoliate a bush within 3 to 4 days. (Ref: TRA Memorandum 27, 1994, P 1 – 36)

Q: What is the meaning of pesticide?

Ans:

- a) Chemical that kills pest is called pesticide.
- b) Pesticide is a broad term. It includes insecticides, acaricides (miticides), fungicides, weedicides (herbicides), nematocides, rodenticides and molluscicides. These pesticides are used for the control of insects, mites, fungal diseases, weeds, nematodes, rodents (rat, mice) and molluscs (snails) respectively.
- c) These are all toxic chemicals and these should be used with statutory protective measures.

(Ref: Chakravartee J, & Kakoty N.N. 1992: An Approach towards Residue Free Pest Control in Tea, Two and a Bud, 99,1, 2-8).

Q. What should be the guideline for diluting and mixing of pesticides to water in the mixing tank when more than one chemical is used for spraying maintaining the compatibility of pesticides?

A:

- a) Liquid chemicals are slowly added to water in the mixing tank.
- b) Dry chemicals are turned into paste with little water and then added to water in the tank slowly.
- c) When using more than one chemical they are to be added to the water one at a time. Stirring should be continued when each is mixed with water.

(Ref: Planters' handbook 1996, p 69)

Q. Generally we find after the name of pesticides some figures are written say in case of Ethion it is written as Ethion 50 EC. What is the meaning of 50 EC?

Ans:

- a) The portion of a pesticide formulation (Ethion 50 EC) which is responsible for pesticidal effects is called Active Ingredient. A **formulation** containing active ingredient and additives (solvent, diluents and emulsifier) makes the application easy. So the formulation, Ethion 50% EC means 50% active ingredient dissolved in the chemical Emulsifying concentrate (EC) which aids in suspending one liquid in another (Planters' Handbook, 1996 p 55-56).

- b) Most of the active ingredients used in pesticide formulations are crystalline solids or oily liquids which are not suitable for direct application. Moreover, only very small quantities of these toxicants (active ingredients) are required for application over large areas. Therefore, these chemicals are made available in a suitably diluted and easily applicable form. (Ref: Muraleedharan 1991, Pest Management in Tea, p.82-83).

Q: what will be length and thickness of spray lance of high volume sprayers?

A: The lance is made of brass tube of variable length (35 cm to 90 cm) with a minimum diameter (6 mm) to withstand pressure.

(Source: Chattopadhyay. S.B. 1980, Principles and Procedures of Plant Protection, p 159).

Q: How much area can be covered by one (a) hand sprayer/day and (b) one power sprayer/day ?

A: (a) Hand sprayer: 0.4 ha (b) Power Sprayer: 1.5 ha

Q: What is the meaning of w/w?

Ans.

- a) One liter of water weighs one kilogram (approx).
- b) The strength of a weight by weight solution is determined by the number of kilogram of Urea dissolved in 100 liters of water (e.g. if 5 kg of Urea is dissolved in 100 liters of water it becomes a 5% w/w Urea solution. - SKD

(Source: Notes & News: Two and a Bud, vol. 15, No.2, June 1968, p80)

Q. It has been reported elsewhere that during winter tea leaves receive considerable quantity of dew on tea bushes in N.E. India. Is it advisable to spray pesticide when dew water remains on tea leaves?

Ans.

- a) Quantity of dew was found to be as high as 700- 900 liters of water per hectare.
- b) Spray fluid of pesticide in this situation if sprayed, will be further diluted. It will be better to wait and allow the water to evaporate before spraying.
- c) Similar condition may occur during monsoon months.

(Phukan B.C. 2001: Lecture Course on Field Management, FAQ & FAQA, Plant Protection p 111).

Q. Is it necessary to spray pesticides following black plucking to control pests infestation?

A: Yes, it is necessary. It is always beneficial to spray pesticides following black plucking to get effective control.

Q: Is it necessary to make a stock solution of a pesticide particularly before mixing it in 200 liters of water in a drum when the recommended quantity of pesticide is small per hectare?

A: Yes, it is necessary to prepare a stock solution first in a small bucket and then gradually pour it into a 200 liter drum adding water to make it a homogeneous spray fluid.

Q. What should be the ideal time for spraying insecticide for the control of Looper ?

A: The ideal time for spraying insecticide for the control of Looper caterpillars is in the afternoon hours as they damage tea leaves maximum during that time. The insecticide remains fresh on the leaves during that time and they die due to stomach poisoning.

Q: How long the efficiency of spray fluid of pesticides after mixing with water will remain ?

A: Pesticides after mixing with water should preferably be used within four hours to avoid loss of efficiency. (Ref: Field Management in tea, 2005, p 161)

Q: Why we do not get adequate control of Red spider mite inspite of sufficient rainfall during monsoon?

A:

- a) As soon as rain starts red spiders on the upper surface of the mature leaves come close and spin a web with silken thread from their saliva to protect themselves against adverse weather conditions (Murleedharan 1991). As soon as rain stops they come out of the web and start sucking the cell sap from the mature leaves.
- b) Adults lay eggs mostly in depressions along the midrib and veins from where rain water cannot wash them down **completely**. Some of the eggs remain attached to their original position.
- c) It is true that some of the red spiders (adults, nymphs and eggs) during rains drop down to middle hamper and lower hamper of the bush canopy due to rain. This is particularly true in the case of unpruned and skiffed tea bushes under longer pruning cycle (Banerjee 1972).
- d) But as soon as rain stops the nymphs and adults come up from the middle and lower zones and start damaging the maintenance foliage of the upper zones (Banerjee 1972).

Ref: (Murleedharan 1991: Pest Management in Tea, p 27-28),

(Banerjee 1972: Rainfall and Pest Activity, Two and A Bud, Vol.19.No 1, p 44-45)

Q: What should be the Economic Threshold Level (ETL) for Tea mosquito bug, Thrips, Jassid (green fly) and Red spider?

A: For Tea mosquito bug 5%, Thrips 3 per shoot, Jassid 3 per shoot and 4 mites per leaf for Red spider. Based on field studies on crop loss due to pests the ETL for the above pests have been worked out. (Ref: Plant Protection Code, August 2017, Ver.9.0, issued by Tea Board of India, p 19).

Q: What should be the number of yellow colour sticky traps to be used on shade tree trunks just above the plucking table of the tea bushes ?

A: About 50 – 70 traps should be used per hectare to control thrips and green fly. The band of bright yellow polythene sheet of 45 cm wide should be fixed.

(Ref: Plant Protection Code, August 2017, Ver. 9.0, p 18-19)

Q. What is the name of adhesive used for smearing the yellow sheets?

A. It is a long lasting glue made with 300 g hot Melt Pressure Sensitive Adhesive Grade OMW 4017 (viscous liquid) in one litre thinner or Tolunene.

(Ref: Plant Protection Code, August 2017, Ver. 9.0, p 18-19)

Q. Can we reuse the yellow sheet when covered with the trapped pests?

A. Yes. The trapped pests should be removed from the yellow sheet periodically by diesel followed by washing with detergent and water. Following drying the yellow sheet after

washing the sticky glue should be smeared again on the yellow sheet. (Ref: **Plant Protection Code, August 2017, Ver. 9.0, p 18-19**)

Q: What is Canker?

A: Canker can be broadly defined as an eating sore or gangrene developing as a result of damage to plant tissues by insects and other organisms. The damage is restricted mostly to the main stem and sometimes to the principal branches. The ultimate results are rotting of bark in patches and exudation of gummy substance from the sore.

(Ref: **Banerjee. B. 1968: Canker on shade trees- An assessment of the problem, Two and A Bud, Vol.15, No.3, p 110-115**)

Q. After helopelties control it is recommended to give rehabilitary spray to boost the growth of the shoots. What should be the composition of rehabilitary spray?

Ans. The composition is as follows:

Nutrients	High volume sprayer	Low volume sprayer (Preferred)
a) Zinc sulphate	: 500 g	1000 g
b) Boric acid	: 250 g	500 g
c) Urea	: 500 g	1000 g
d) Water	: 200 liters	200 lit.
e) Intervals	: 15 days	15 days
f) No. of rounds	: 2	2

(Ref: **Phukan B.C (2001) Lecture Course on Field Management (FAQ & FAQA), p 88 under Plant Protection**)

Q: How long it takes for a systemic pesticide to go inside the plant system after spraying?

Ans: Systemic pesticides go into the plant system within 2-3 hours after spraying. (Ref: **Lecture Course on Field Management, 2001, FAQ &FAQA, p 98**)

Q : What is the period of persistency of pesticides on tea foliage?

Ans: Depending on the type of chemical 7 – 10 days in summer and 10 – 14 days in winter under normal weather conditions.

(Ref: **Phukan B. C. CAO, 2001:Lecture Course on Field Management, FAQ &FAQA, p 98**)

Q. Can you name some of the recommended termiticides?

Ans: Recommended termiticides are:

- Chlorpyrifos (1: 300),
- Imidacloprid (70 ml in 200 lit. of water),
- Bifenthrin 10 EC (Marker 100 ml in 200 lit. of water),
- Fifronil 80 WG (**Jump** 8 g/ 200 lit of water). Jump was found to be very effective in termite control in some of the Cachar gardens.
- About 2000- 3000 liter of spray fluid will be required per hectare (10- 15 drams/ha).

Q. What is meant by LD₅₀?

Ans.

- LD₅₀ (LD means Lethal Dose) is defined as the dose of the pesticide in mg /kg body weight of a mammal which is capable of killing 50 % of the tested animals (mammals).
- Toxicity of a pesticide is expressed in terms of mammalian toxicity as LD₅₀ values which give an indication about the toxicity of the pesticides. Higher the LD₅₀ value safer is the pesticide.
- Pesticides are classified into different categories depending on the LD₅₀ values.

Categorization of pesticides (Value in mg/kg body weight)

Categories	LD50 (oral)	LD50 (Dermal)	Colour code
Extremely toxic	1- 50	1-200	Bright Red
Highly toxic	51 – 500	200 – 2000	Bright Yellow
Moderately toxic	501 – 5000	2001 -20000	Bright Blue
Slightly toxic	above 5000	above 20000	Bright green

LD₅₀ (oral) & LD₅₀ (Dermal) values of some of the pesticides on use in tea

Value in mg/kg body weight

Pesticides	LD 50 (oral)	Category	LD50 (Dermal)
Furadon 3G	8 (Rat)	ET	
Quinalphos	71 (Rat)	HT	1750 (Rat)
Chlorpyrifos	135-163 (Rat)	HT	2000 (Rabbit)
Phosalone	120-175 (Rat)	HT	1530 (Rabbit)
Fenitrothin	1700 (Rat)	MT	1300 (Rat)
Fenprothrin	70.6 (rat)	HT	
Ethion	208 (Rat)	HT	915 (Rat)
Dicofol	above 5000 (Rat)	MT	1870 (Rat)
Deltamethrin	5000 (Rat)		
Cypermethrin	4150 (Rat)	MT	4100 (Rabbit)
Alphamethrin	400 (Rat)	HT	
Diuron	3400 (Rat)	MT	NA
Oxyfluorfen	above 5000 (Rat)	ST	10000 (Rabbit)
Glyphosate	4300 (Rat)	MT	7940 (Rat)
Paraquat	150 (Rat)	HT	NA

ET= Extremely toxic, HT = Highly toxic, MT = Moderately toxic, ST= Slightly toxic

(Ref: Chakravartee J & Kakoty N.N. 1992: An Approach Towards Residue Free Pest Control in Tea, Two and a Bud 39, vol.1, p 2-8)

Q: What is pesticide residue?

Ans: Pesticide residue means remnant of the applied pesticide remains on a food product following a time lapse after application.

Q. What is MRL?

Ans.

- The maximum concentration of a pesticide residue (remnants) legally permitted in food commodities is called MRL. It is expressed as ppm in made tea.

- b) MRL (Maximum Residue Limit) is established taking into account the toxicological data of pesticide as well as that of the residue on crop.

(Ref: Barooah. A.K. 2005: Field Management in Tea, p 213- 220)

Q: What is the purpose of setting MRL?

Ans : The **primary purpose** of setting MRLs (Maximum Residue Limits) for pesticide residues in food is to protect the health of the consumer.

Q: How MRLs are established?

A: MRLs are established only where there is supporting evidence concerning the safety to humans of the resulting residues as determined by the Joint FAO/WHO Meeting on Pesticide Residue.

Q : What is the composition of Alkaline wash?

A: Any of the composition mentioned below may be used for Alkaline wash:

- a) Quick lime 2- 3 kg + Washing soda 6 kg in 100 liters of water
- b) Quick lime 2 - 3 kg + Soda ash 1.5 kg in 100 liters of water
- c) Quick lime 2 - 3 kg + Caustic soda 2 kg in 100 liters of water

Tea seeds & Seed bari

Q. What is the right time of harvesting tea seeds from seed bearers?

A. Generally seeds drop from seed bearers from October onwards and collected from the ground every day during morning hours.

The seeds also can be harvested when the colour of the fruit (capsule) changes from green to brown. **(Ref: Guidelines on tea culture in South India, UPASI, p 17)**

Q. How long the viability of tea seeds remains after dropping from seed trees?

A:

- a) Tea seed at the time of dropping from seed trees retains 40% moisture. Tea seeds need 33% moisture content to retain its viability and if the moisture content of the tea seeds drop below 33% then viability is affected.
- b) In general it was found that viability remains about 30 days from the time of dropping. **(Ref: Guidelines on tea culture in South India, UPASI, p 17)**

Q: Is it possible to extend the period of viability of tea seeds?

A: a) Yes it is possible. After washing the seeds with 0.1% mercuric chloride storing the seeds at 4°C-7°C up to one year can be done without any deterioration in quality of germination. The seeds retain their viability even after one year and there are no set back due to storage. Hence cold storage of tea seeds can be done with advantage to adjust the sowing and planting time.

(Ref: Dr L. Manivel's (former plant physiologist ,TRA's letter no. 0307/B.86/10268 dt 21. 10. 1986)

Q: Will you please tell us the life of a tea flower?

Ans:

The tea flower buds in the seed trees become visible from about June and they require about 120 to 150 days for development to come into flowering.

Life of a tea flower after opening varies from 24 to 48 hours after which corolla withers and together with the anther lobes drops from pedicel leaving the ovary exposed.

Observations on the time of opening of flower revealed no fixed timing. It takes place any time during day and night.

(Ref: Two and A Bud, vol. 22, No. 1, June 1975, p 28)

Nutrition:

Q: When the use of inorganic manure (fertilizer) started in tea?

A: After First World War a few enterprising planters started manuring tea field with SOA. Results being encouraging the use of this form of nitrogen gradually spread. Prior to First World War organic manure was only used. (Ref: Science & Practice in Tea culture 1989, p 443)

Q: What is the difference between Urea and SOA?

A: Urea contains 46% Nitrogen only but SOA contains 20.6% Nitrogen and 24% Sulphur. Urea is more hygroscopic than SOA. Volatilization loss of Nitrogen is more from Urea. (Ref: Notes on Field Management, 2002, p. 108)

Q: What is amide fertilizer?

A: There are four forms of fertilizers. They are

- a) ammoniacal fertilizer (example SOA),
- b) Chilean nitrate,(example : Calcium nitrate),
- c) Combine ammoniacal and nitrate Fertilizer (example: CAN,) and
- d) Amide fertilizers: Amide fertilizers are carbon compounds. Nitrogen in amide form is not directly available to the plant. It has to be made available by microbial action in the soil. Urea is the most common amide fertilizer. Urea contains 46% Nitrogen.

(Ref: Handbook on Fertilizer Usage 1977, p 111-112. The Fertilizer Association of India, New Delhi. Updated by: R.N.Roy and S. Seetharaman).

Q: What is the difference between Rock phosphate and Single super phosphate?

A: Rock phosphate contains 20 to 24% phosphate (acid soluble). Single super phosphate contains 16% phosphate and 11.9% Sulphur. (Ref: Notes on Field Management, 2002, p 108).

Q: Why we add filler when we make YTD mixture?

Ans:

- a) Loss of Nitrogen from Urea was found to be at least 50 per cent higher than from Ammonium sulphate (SOA). Cause of high volatilization loss of ammonia from Urea than from SOA was found to be the cause of this malady.
- b) "Nitrogen loss was not affected when Urea was mixed with MOP and SSP. But burial of Urea a few centimeters below the soil level reduced the loss considerably.
- c) As cost of manuring will go high if we place the manure few centimeters below the soil of each plant to reduce nitrogen loss where application of manure per plant is practiced" (1).
- d) Perhaps that is the reason filler (inert materials) is added to reduce the volatilization loss of nitrogen to some extent from urea when manure is applied in less ground covered areas.
- e) Filler also helps to increase the bulk of fertilizers and also dilutes the change of fertilizer injury to young plants.

- f) When ground is more or less covered no need to add fillers as we do broadcast in case of mature tea or youngish mature tea.

1.(Ref: Barua D. N. 1989: Science and Practice of Tea Culture p 497)

Q: What should be the application area in case of single bush manuring?

Ans: Calculation of single bush manuring zone is as follows:

Assuming the estimated spread (canopy) is 60 cm of the plucking table

$\frac{1}{3}$ of 60 cm = 20 cm (unmanured area from the collar area),

60 cm + 20 cm = 80 cm (10cm + 10 cm on both sides from the collar)

$\frac{1}{2}$ of 80 cm = 40 cm (Outer zone of the manuring area from collar)

So the manure application zone will be 40 – 10 = 30 cm i.e. the area between 40 cm and 10 cm leaving from collar i.e. 30 cm is the manuring area.

(Source: Tea Encyclopaedia Serial No. 9/5, p 3 filed under D 1).

Q: Can foliar application of Vermiwash helps to increase crop?

Ans:

- Foliar application of Vermiwash (5 – 10%) has been found to be effective on the growth and productivity of young and unpruned mature tea. It is easily producible, eco-friendly and may be one of the best liquid organic nutrient supplements for foliar application in tea.
- Vermiwash prepared from Mikania contains highest amount of Potash (200 mg l⁻¹) which could be utilized in organic tea as foliar spray for Potash supplementation).
(Ref: Science and Culture, vol.77, No.9-10, September-October 2011, p 425-428)

Q: We use wood ash in shade tree pits at the rate of 500 g per pit. What are the nutrients this wood ash contain?

Ans: Wood ash contains 22% Calcium, 4-5% Potash and some amount of Magnesium. (Ref: Hand book of manure and fertilizer, p 6)

Q: I want to manure my tea field with cattle manure at the rate of 40 kg N/ha. How much cattle manure will be required?

A: About 8-9 tons of cattle manure to be added annually.(1)

Q: We want to apply 40 kg Nitrogen/ha with the loppings of Boga medelwa. Please tell us the requirement of Boga medelwa for one hectare.

A: About 4.5 tonnes of fresh green materials will be required.(1)

(Ref: 1. S K Dey, Bienneal Conference, Tocklai)

Q. Apart from Nitrogen what other elements Urea contains?

A: Apart from **Nitrogen 46.67%** Urea contains **Carbon 20%**, **Oxygen 26.67%** and **Hydrogen 6.66%**.

Calculation:

Formula for Urea: CO (NH₂)₂

Molecular weight of the elements:

Element	Atomic weight	Atomic Number
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Carbon (C)	=12	6
Oxygen (O)	= 16	8
Nitrogen (N)	=14	7
Hydrogen(1)	= 1	1

C (12)+ O (16) + N (14 x2 H1 x 2 x 2)= 60

Carbon = 12 = 12/60 = 20.00%

Oxygen = 16 = 16/60= 26.67%

Nitrogen = 14 x 2 = 28 /60= 46.67 %

Hydrogen= 1x2x2= 4/60 = 6.66%

Total =100.00

Q: Is growth promoter a substitute of ground application of N P K?

A: No. Foliar application of growth promoters/nutrients is not considered as a substitute of ground application of N P K. But foliar application of growth promoters was found to increase crop to some extent when sprayed over basal dose (ground application) of NPK.

Weedicides & their application:

Q: After how many days the visible symptoms of glyphosate injury will develop when Glyphosate is sprayed on weeds?

A: Glyphosate being a translocated herbicide visible symptom of glyphosate injury on weeds develop slowly. The visible effects normally appear within 2-4 days in annual species and 7 –10 days in perennial species. Cool or cloudy weather condition may delay appearance of visible symptoms.

. (Ref: Dutta A.K., Kotoky,B. and Bora k: Tea weeds and their control, Notes on Field Management, p 141- 144)

Q: What should be the minimum gap of spraying translocated herbicide and harvesting of tea shoots?

A: Minimum gap of about 7 days between spraying of translocated herbicide and harvesting of tea shoots to avoid herbicide residue in made tea.

(Ref: Plant Protection Code, August 2017, Ver 9.0 by Tea Board, p 27)

Q: What are the toxicity symptoms of Glyphosate?

A: Glyphosate toxicity symptoms are: defoliation of leaves, appearance of small multiple growth of shoots from the axil buds similar to boron deficiency. (Ref: Lecture Course on field management, FAQ and FAQA 2001 questions of TRA, p 69).

Q: How to detoxify glyphosate toxicity?

A: A cocktail of Zinc sulphate (1%) and Borax or Boric acid (0.25%) should be sprayed for two rounds at fortnightly intervals.

(Ref: TRA Lecture Course on field management, FAQ and FAQA 2001 , p 69).

Tea diseases:

Q: In the plains of N.E. India in general tea bushes are infected with three diseases on their above ground part. Can you name some of the diseases?

Ans:

- a)** Black rot (a leaf disease), **b)** Red rust (a stem disease) and **c)** Fusarium (a disease of succulent stems and shoots).

Tea quality

Q: What is meant by tea quality?

A: The majority of the investigations confirm that in teas Briskness, Strength and Colours represent QUALITY. The higher the tannin (polyphenols) content of tea leaf the greater is the possibilities of obtaining a good quality tea.

Q: Why two leaves and a bud when plucked and manufactured give good quality?

A: Percent Tanin (polyphenols) contents of two leaves and a bud is higher as given below:

Bud	: 27.8%
First leaf	: 27.9%
Second leaf	: 21.3%

After that it starts deteriorating as follows:

Third leaf	: 17.8%
Fourth leaf	: 14.5%
Upper stalk	: 11.7%
Lower stalk	: 6.4%

A: Tea plant requires about 16 ppm Iron.
 (Ref: ASC, North Bank, 28.05.1987),

Q: What is meant by ppm?

Ans: PPM means Parts per Million (i.e. 1 part in a Million).

1 million = 10, 00,000,

Say 1 ml in 1000 liters of water (i.e. 1000 x 1000 = 10, 00,000 ml) or

1 ml in 10, 00,000 ml of water is 1 ppm or

1 g in 10, 00,000 ml of water is 1 ppm.

Q: How to calculate the cross sectional area of the drain?

A: Calculation of cross sectional area of the drain will be as follows:

Cross sectional area of the drain will be as follows:

$$= \frac{\text{Top width} + \text{Bottom width} \times \text{depth}}{2} = \text{sq.ft.}$$

$$= \frac{(4 \text{ ft} + 1 \text{ ft}) \times 3 \text{ ft}}{2} = 7.5 \text{ cu. feet (4 ft= 1 ft+ 1.5 ft+ 1.5 ft)}$$

$$\text{Length} = 100 \times 7.5 \text{ cft} = 750 \text{ cft (Total earth work)}$$

Q: What will be the earth cutting of a field drain in heavy soil having 1 foot top width, 1 foot bottom width and 3 feet depth and 100 feet length?

$$\text{A: Cross sectional area} = \frac{\text{Top width} + \text{Bottom width} \times \text{depth}}{2} = \text{sq.ft}$$

$$= \frac{1 \text{ foot} + 1 \text{ foot} \times 3 \text{ feet}}{2} = 6$$

$$= 3 \text{ cu.ft}$$

$$\text{Total earth cutting} = \text{Earth work} / \text{Volume} = 100 \text{ feet} \times 3 \text{ ft} = 300 \text{ cft}$$

