Bulletin No. 42

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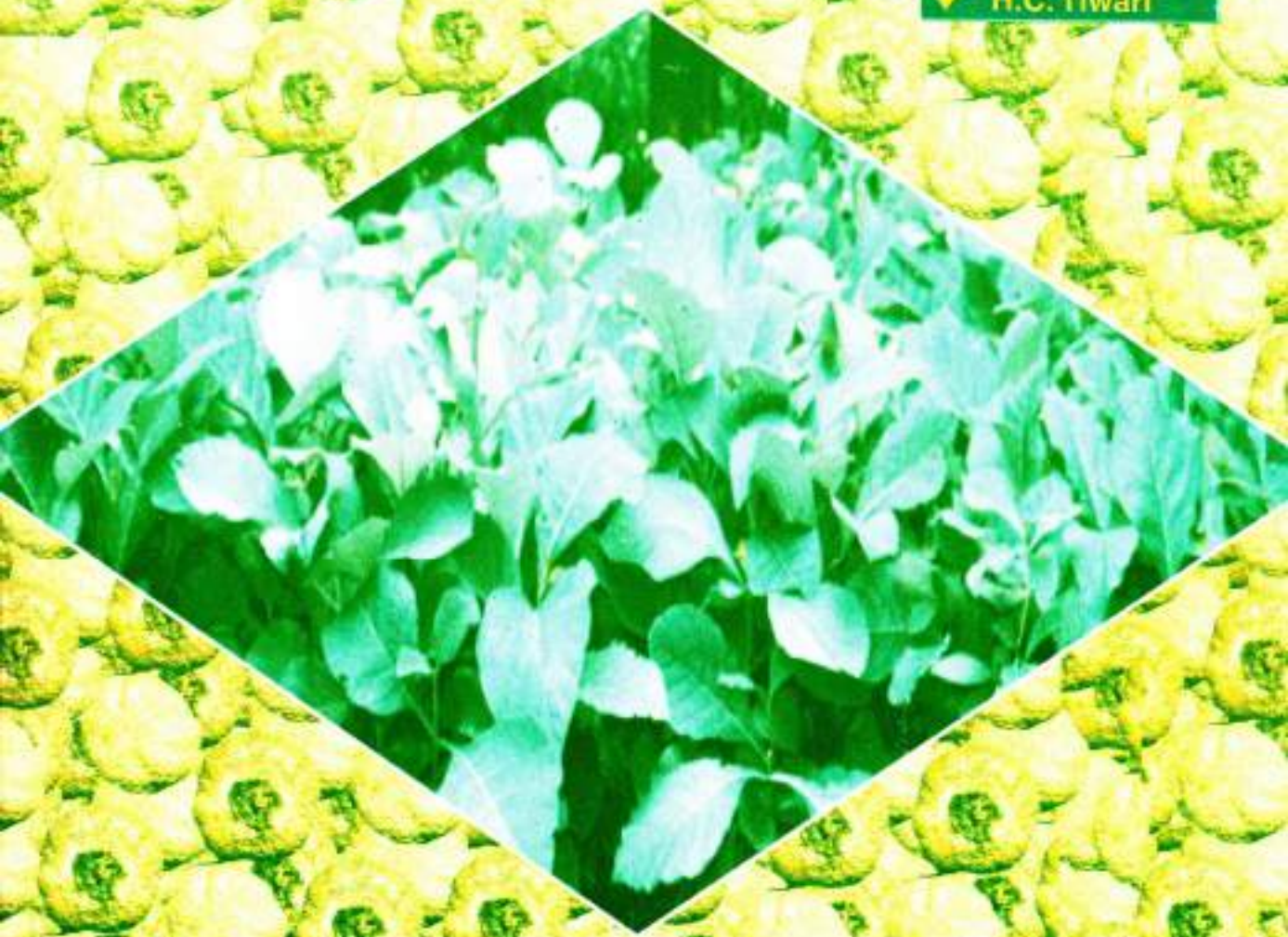

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APPLICATION OF LABORATORY SEED TESTING RESULTS IN NURSERY PRACTICES.

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STATE FOREST RESEARCH INSTITUTE
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PREFACE

The demand for planting stock has consequently increased enormously. A large number of new nurseries have been established by M.P. Forest Department to meet the increasing demand of plantable stock.

For any species and for a particular collection year the behaviour of seed can not be predicted unless it is examined in seed testing laboratory. The science of seed testing has been developed to achieve the following objectives for minimising the risk of obtaining inadequate planting stock due to poor germination of the seed :-

1. To determine their quality i.e. their suitability for planting.
2. To identify seed quality problems and their probable causes.
3. To determine the need for drying and processing the specific procedures that should be used.
4. To determine if seed meets the established quality standards of labelling specifications.
5. To establish quality and provide a basis for price and consumer discrimination among lots in the market.

State Forest Research Institute Jabalpur was established in 1963 by Govt. of M.P. and the Seed Certification Cell was established in 1981 under the Indo-Danish project on Tree improvement and seed certification.

This research Bulletin may be helpful for the persons who are engaged in nursery practices. This publication consist of the application of laboratory test results in nursery practices. A user can substitute the laboratory test results of any seed lot of any species in the given blanks .....A, ...B, ...C, of that species and find out the kilogram effective factor. The figure thus obtained is multiplied with the standard KEF of the species to obtain the weight in kilogram required for raising 10,000 seedlings. The present Bulletin will help to find out the seed weight needed to raise the given number of planting stock.

Sincere thanks are due to Dr. Parvez Jalil who has been associated with the seed testing laboratory of the institute in previous years. The authors also are thankful to Mr. Sajal Dhagat for computer help and neat typing.

Authors

Contents

INTRODUCTION

Field germination of any species in an operational nursery will often differ from test germination. It may be considerably lower that than in ideal conditions of a laboratory test and some what lower than in a research nursery. Observations on the differences between laboratory and nursery germina' trials in Sudan have been reported by Wunder (1966). Differences varied with species and in some cases speed of germination was affected more than the final number germinated.

Variations between nurseries may be associated with a number of different climatic, soil or cultural factors. As an example, Roney and Brown (1978) found that germination of *Pinus ponderosa* was 38%, better if the seeds were covered with a depth of 1.5 cm of girth than if covered with a depth of 0.4 cm. Frequency of watering also has a significant effect on germination (Costales and Varacion 1978). Some loses may occur in seed beds or during transplant beds, or the least vigourous surviving plants may be culled at planting time. All these factors together combine to make the number of plantable plants raised per unit weight of seed, much less than the number of germinated seeds indicated by testing. The nursery man must make an equivalent increase in the quantity of seed sown. The term plant percent or tree percent is frequently used to combine these factors.

In practice, the record of plant yields obtained from any given nursery provides the most useful basis for estimating further production from that locality (Aldhous 1972). Records based on production on other soil types or in other climatic conditions are of very little help where experience is lacking as in the early years of new nurseries, only rough "guestimates" are possible. In Zambia a reduction factor of 20% was allowed for the difference between laboratory and field germination in both Pines and Eucalyptus (Allan and Endean 1966).

The concept of effective kilogram of seed which is use now in several countries has been found useful in planing sowing programmes and in calculating seed prices (Aldhous 1972). The "effective kilogram" is defined as the weight of seed of any particular seed lot which can be expected to produce the same number of viable seeds or plantable plants as would be produced by one kilogram of standard seed. It is the ratio of standard seedling recovery to actual seedling recovery of a given seed lot. The kilogram effective factor can then be used in conjuction with standard seedling recovery to calculate the weight of seed required to raise any given number of plants. Standards are determined for each species from the average of previous experiences (Willan 1985).

In the present study a trial has been made to establish the standard seedling recovery and nursery recovery factor for different forest tree species, which are tested in seed certification laboratory and also tried in nursery of State Forest Research Institute, Jabalpur.

OBJECTIVES

Ultimately our target is to make successful the various plantation programmes and for a plantation a number of seedlings are required. Before seed sowing so many questions arises about the number of seedling required, weight of seeds to be sown, preparation of number of seed beds etc. To solve all these questions, information about the standard of the species are required. The main objective of the present study is :-

To establish the standard seedling recovery and nursery recovery factor for different forest tree species to find out the seed weight needed to raise the given number of seedlings.

MATERIALS AND METHODS

(1) Laboratory Seed Testing : Seed testing is routine work of the Seed Certification Laboratory, State Forest Research Institute, Jabalupr. The testing parameters are as follows :-

(a) Purity Test : The purity test determine the composition of clean seeds by weight of the samples.

$$\text{Purity \%} = \frac{\text{Weight of clean seeds}}{\text{Weight of total seed sample}} \times 100$$

(b) Seed Weight : Seed weight per kilogram was calculated on the basis of 1000 pure seed weight.

$$\text{Seed per Kilo} = \frac{1000000}{\text{Weight of 1000 seeds in gram}}$$

(c) Germination Test : The percentage of seeds which are capable to produce a normal plant under favourable condition is known as germination percentage. Test was conducted according to ISTA Rules (1985).

(d) Plant Percent : The percentage of seeds which develop into plantable plants at the end of a given period.

(2) Standard for nursery application:

To calculate the standard figure for purity percent, seed weight per kg., germination percent and plant percent, the average value of previous years testing are computed. Data of the same source are considered here and seed source of the particular species are given in Table-1.

(a) Standard seedling recovery/Plantable plant per kg.

= No. of pure seed/kg x purity factor x plant factor

$$\text{where :- Purity factor} = \frac{\text{purity percent}}{100}$$

$$\text{Plant factor} = \frac{\text{Plant percent}}{100}$$

(b) Nursery recovery factor = $\frac{\text{Plant percent}}{\text{Germination percent}}$

(c) Kilogram effective factor (KEF) =

$$= \frac{\text{Standard seedling recovery}}{\text{No. of pure seed/kg x purity factor x germination factor x nursery recovery factor}}$$

It is necessary to test the any seed lot before sowing because seed weight per kg. purity factor and germination factor may vary from lot to lot. The germination factor also vary with the age of seed lot. ***Unfortunately the seed lot could not be tested then the KEF can be consider as 1, the standard value.***

(d) Seed weight needed to raise 10,000 seedling :-

$$= \frac{\text{KEF x No of plants to be raised}}{\text{Standard seedling recovery}}$$

After getting the amount of seed weight to be sown, the number of seed per bed and total number of seed bed needed, can be calculated as follows :-

(i) Weight of seed per seed bed =

$$= \frac{\text{Size of one seed bed/m}^2 \times \text{Desired final stocking of seedlings/m}^2}{\text{No. of seeds per kg. x purity factor x Germination factor x Nursery recovery factor}}$$

(ii) No. of seed beds needed $= \frac{\text{Total seed wt. to be sown}}{\text{Required seed wt. per bed}}$

OBSERVATION AND RESULTS

Standard figure of standard seedling recovery and nursery recovery factor for 50 tree species has been calculated and results are shown below :

Following abbreviations are used during the expression of the results.

KEF = Kilogram effective factor

A = No. of seed per Kg.
B = Purity factor] **of the given seed lot**
C = Germination factor

Table-1: Seed source of the species, considered during the data compilation.

S.N.	Name of Species	Local Name	Seed Source
1.	Acacia auriculiformis	Australian babul	Morena
2.	Acacia camplycantha	Acacia camplycantha	Jabalpur
3.	Acacia catechu	Khair	Morena
4.	Acacia leucophloea	Ranjha	Morena
5.	Acacia nilotica	Babul	Morena
6.	Adina cordifolia	Haldu	Bilaspur
7.	Albizzia amara	Kastar	Raipur
8.	Albizzia lebbek	Kala siris	Balaghat
9.	Albizzia procera	Safed siris	Raipur
10.	Anogeissus latifolia	Dhawra	Raipur
11.	Anogeissus pendula	Kardhai	Morena
16.	Boswelia serrata	Salai	Amarkantak
17.	Bridelia retusa	Kasai	Indore
18.	Buchnania lanzen	Achar	Bilaspur
19.	Cassia fistula	Amaltas	Seoni
20.	Cliestanthus collinus	Garari	Bilaspur
21.	Dalbergia latifolia	Seasum	Jabalpur
22.	Dalbergia sissoo	Sissoo	Seoni
23.	Dendrocalamus strictus	Bans	Betul
24.	Diospyros melanoxylon	Tendu	Jagadalpur

25.	Emblica officinalis	Aonla	Panna
26.	Eucalyptus camendulensis	Nilgiri	Amarkantak
27.	Eycalyptus hybrid	Nilgiri	Bilaspur
28.	Gmelina arborea	Khamer	seoni
29.	Grevillia pteridifolia	G. pteridifolia	Amarkantak
30.	Grevillia robusta	Silver oak	Amarkantak
31.	Hardwickia binnata	Anjan	Raipur
32.	Holoptelia integrifolia	Chirol	Jabalpur
33.	Jatropha curcus	Ratanjot	Jabalpur
34.	Lagerstroemia parviflora	Lendia	Balaghat
35.	Lucaena leucocephala	Subabul	Morena
36.	Mallotus phillipinensis	Sinduri	Nepanagar
37.	Mimusops elengi	Molshri	Nepanagar
38.	Mitragyna parvifolia	Mundi	Bilaspur
39.	Pongamia pinnata	Karanj	Amarkantak
40.	Prosopis juliflora	Prosopis	Bilaspur
41.	Pterocarpus marsupium	Bija	Amarkantak
42.	Putranjiva roxburghii	Putranjiva	Nepanagar
43.	Santalum album	Chandan	Jabalpur
44.	Schleichera trijuga	Kusum	Seoni
45.	Semecarpus anacardium	Bhilwa	Bilaspur
46.	Tectona grandis	Sagaon	Jabalpur
47.	Terminalia arjuna	Arjun	Jabalpur
48.	Terminalia bellarica	Bahera	Jabalpur
49.	Terminalia chebula	Harra	Sihore
50.	Terminalia tomentosa	Saja	Kundam

(1) ***Acacia auriculiformis***

No. of pure seed per Kg.	=	41500
Purity percent	=	96
Germination percent	=	52
Plant percent	=	25

(a) **Standard seedling recovery :**

= 41500 x .96 x .25

= 9960

(b) **Nursery recovery factor :**

$$= \frac{25}{52}$$

= .48

(c) **Kilogram effective factor :**

$$= \frac{9960}{\text{.....A x .....B x ..... C x .48}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{9960}$$

= ..... Kg seed.

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(2) ***Acacia camplycantha***

No. of pure seed per Kg.	=	13500
Purity percent	=	92
Germination percent	=	30
Plant percent	=	10

(a) **Standard seedling recovery :**

= 13500 x .92 x .10

= 1242

(b) **Nursery recovery factor :**

$$= \frac{10}{30}$$

= .33

(c) **Kilogram effective factor :**

$$= \frac{1242}{\text{.....A x .....B x ..... C x .33}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{1242}$$

= ..... Kg seed.

(3) ***Acacia catechu***

No. of pure seed per Kg.	=	27400
Purity percent	=	92
Germination percent	=	70
Plant percent	=	6

(a) **Standard seedling recovery :**

= 27400 x .92 x .06

= 1512

(b) **Nursery recovery factor :**

$$= \frac{6}{70}$$

= .08

(c) **Kilogram effective factor :**

$$= \frac{1512}{\text{.....A x .....B x ..... C x .08}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{1512}$$

= ..... Kg seed.

---

(4) ***Acacia leucophloea***

No. of pure seed per Kg.	=	7600
Purity percent	=	94
Germination percent	=	50
Plant percent	=	20

(a) **Standard seedling recovery :**

= 7600 x .94 x .20

= 1429

(b) **Nursery recovery factor :**

$$= \frac{20}{50}$$

= .40

(c) **Kilogram effective factor :**

$$= \frac{1429}{\text{.....A x .....B x ..... C x .40}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{1429}$$

= ..... Kg seed.

(5) ***Acacia nilotica***

No. of pure seed per Kg. = 7132
Purity percent = 95
Germination percent = 50
Plant percent = 25

(a) **Standard seedling recovery :**

= 7132 x .95 x .25
= 1694

(b) **Nursery recovery factor :**

$$= \frac{25}{50}$$
= .50

(c) **Kilogram effective factor :**

$$\frac{1694}{\text{.....A x .....B x ..... C x .50}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{1694}$$
= ..... Kg seed.

---

(6) ***Adina cordifolia***

No. of pure seed per Kg. = 11000000
Purity percent = 35
Germination percent = 80
Plant percent = 10

(a) **Standard seedling recovery :**

= 11000000 x .35 x .10
= 385000

(b) **Nursery recovery factor :**

$$= \frac{10}{80}$$
= .12

(c) **Kilogram effective factor :**

$$\frac{385000}{\text{.....A x .....B x ..... C x .12}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{385000}$$
= ..... Kg seed.

(7) ***Albizzia amara***

No. of pure seed per Kg.	=	12655
Purity percent	=	90
Germination percent	=	60
Plant percent	=	25

(a) Standard seedling recovery :

= 12655 x .90 x .25

= 2847

(b) Nursery recovery factor :

$$= \frac{25}{60}$$

= .41

(c) Kilogram effective factor :

$$= \frac{2847}{\text{.....A x .....B x ..... C x .41}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{2847}$$

= ..... Kg seed.

---

(8) ***Albizzia lebbek***

No. of pure seed per Kg	=	8200
Purity percent	=	80
Germination percent	=	35
Plant percent	=	20

(a) Standard seedling recovery :

= 8200 x .80 x .20

= 1312

(b) Nursery recovery factor :

$$= \frac{20}{35}$$

= .57

(c) Kilogram effective factor :

$$= \frac{1312}{\text{.....A x .....B x ..... C x .57}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{1312}$$

= ..... Kg seed.

(9) ***Albizzia procera***

No. of pure seed per Kg. = 19150
Purity percent = 94
Germination percent = 55
Plant percent = 27

(a) **Standard seedling recovery :**

= 19150 x .94 x .28
= 4860

(b) **Nursery recovery factor :**

$$= \frac{27}{55}$$
= .49

(c) **Kilogram effective factor :**

$$= \frac{4860}{\text{.....A x .....B x ..... C x .49}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{4860}$$
= ..... Kg seed.

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(10) ***Anogeissus latifolia***

No. of pure seed per Kg. = 118500
Purity percent = 78
Germination percent = 6
Plant percent = 4

(a) **Standard seedling recovery :**

= 118500 x .78 x .04
= 3697

(b) **Nursery recovery factor :**

$$= \frac{4}{6}$$
= .66

(c) **Kilogram effective factor :**

$$= \frac{3697}{\text{.....A x .....B x ..... C x .66}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{3697}$$
= ..... Kg seed.

(11) ***Anogeissus pendula***

No. of pure seed per Kg.	=	124350
Purity percent	=	76
Germination percent	=	4
Plant percent	=	2

(a) **Standard seedling recovery :**

= 124350 x .76 x .02

= 1890

(b) **Nursery recovery factor :**

$$= \frac{2}{4}$$

= .50

(c) **Kilogram effective factor :**

$$= \frac{1890}{\text{.....A x .....B x ..... C x .50}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{1890}$$

= ..... Kg seed.

---

(12) ***Anthocephalus kadamba***

No. of pure seed per Kg.	=	12300000
Purity percent	=	36
Germination percent	=	30
Plant percent	=	10

(a) **Standard seedling recovery :**

= 12300000 x .36 x .10

= 442800

(b) **Nursery recovery factor :**

$$= \frac{10}{30}$$

= .33

(c) **Kilogram effective factor :**

$$= \frac{442800}{\text{.....A x .....B x ..... C x .33}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{442800}$$

= ..... Kg seed.

(13) ***Bambusa arundinaceae***

No. of pure seed per Kg. = 70455
Purity percent = 87
Germination percent = 50
Plant percent = 50

(a) **Standard seedling recovery :**

= 70455 x .87 x .50
= 30648

(b) **Nursery recovery factor :**

$$= \frac{50}{50}$$
= 1.0

(c) **Kilogram effective factor :**

$$= \frac{30648}{\text{.....A x .....B x ..... C x 1.0}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{30648}$$
= ..... Kg seed.

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(14) ***Bauhinia malabarica***

No. of pure seed per Kg. = 4350
Purity percent = 95
Germination percent = 70
Plant percent = 65

(a) **Standard seedling recovery :**

= 4350 x .95 x .65
= 2686

(b) **Nursery recovery factor :**

$$= \frac{65}{70}$$
= .92

(c) **Kilogram effective factor :**

$$= \frac{2686}{\text{.....A x .....B x ..... C x .92}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{2686}$$
= ..... Kg seed.

(15) *Bauhinia variegata*

No. of pure seed per Kg.	=	4225
Purity percent	=	94
Germination percent	=	55
Plant percent	=	50

(a) Standard seedling recovery :

= 4225 x .94 x .50

= 1985

(b) Nursery recovery factor :

$$= \frac{50}{55}$$

= .90

(c) Kilogram effective factor :

$$= \frac{1985}{\text{.....A x .....B x ..... C x .90}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{1985}$$

= ..... Kg seed.

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(16) *Boswelia serrata*

No. of pure seed per Kg.	=	17860
Purity percent	=	94
Germination Percent	=	20
Plant percent	=	15

(a) Standard seedling recovery :

= 17860 x .94 x .15

= 2518

(b) Nursery recovery factor :

$$= \frac{15}{20}$$

= .75

(c) Kilogram effective factor :

$$= \frac{2518}{\text{.....A x .....B x ..... c x .75}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{2518}$$

= ..... Kg seeds.

(17) ***Bridelia retusa***

No. of pure seed per Kg. = 5950
Purity percent = 96
Germination percent = 25
Plant percent = 15

(a) **Standard seedling recovery :**

= 5950 x .96 x .15
= 857

(b) **Nursery recovery factor :**

$$= \frac{15}{25}$$
= .60

(c) **Kilogram effective factor :**

$$= \frac{857}{\text{.....A x .....B x ..... C x .60}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{857}$$
= ..... Kg seed.

---

(18) ***Buchnania lanzen***

No. of pure seed per Kg. = 2705
Purity percent = 94
Germination percent = 75
Plant percent = 15

(a) **Standard seedling recovery :**

= 2705 x .94 x .15
= 390

(b) **Nursery recovery factor :**

$$= \frac{15}{75}$$
= .20

(c) **Kilogram effective factor :**

$$= \frac{390}{\text{.....A x .....B x ..... C x .20}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{390}$$
= ..... Kg seed.

(19) ***Cassia fistula***

No. of pure seed per Kg.	=	6270
Purity percent	=	93
Germination percent	=	15
Plant percent	=	10

(a) **Standard seedling recovery :**

= 6270 x .93 x .10

= 583

(b) **Nursery recovery factor :**

$$= \frac{10}{15}$$

= .66

(c) **Kilogram effective factor :**

$$= \frac{583}{\text{.....A x .....B x ..... C x .66}} \text{ KEF}$$

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{583}$$

= ..... Kg seed.

---

(20) ***Clistenthus collinus***

No. of pure seed per Kg.	=	8500
Purity percent	=	94
Germination percent	=	25
Plant percent	=	12

(a) **Standard seedling recovery :**

= 8500 x .94 x .12

= 959

(b) **Nursery recovery factor :**

$$= \frac{12}{25}$$

= .48

(c) **Kilogram effective factor :**

$$= \frac{959}{\text{.....A x .....B x ..... C x .48}} \text{ KEF}$$

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{959}$$

= ..... Kg seed.

(21) ***Dalbergia latifolia***

No. of pure seed per Kg. = 43600
Purity percent = 95
Germination percent = 80
Plant percent = 35

(a) **Standard seedling recovery :**

= 43600 x .95 x .35
= 14497

(b) **Nursery recovery factor :**

$$= \frac{35}{80}$$
= .43

(c) **Kilogram effective factor :**

$$= \frac{14497}{\text{.....A x .....B x ..... C x .43}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{14497}$$
= ..... Kg seed.

---

(22) ***Dalbergia sissoo***

No. of pure seed per Kg. = 51850
Purity percent = 91
Germination percent = 80
Plant percent = 42

(a) **Standard seedling recovery :**

= 51850 x .91 x .42
= 1429

(b) **Nursery recovery factor :**

$$= \frac{42}{80}$$
= .52

(c) **Kilogram effective factor :**

$$= \frac{1429}{\text{.....A x .....B x ..... C x .52}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{1429}$$
= ..... Kg seed.

(23) *Dendrocalamus strictus*

No. of pure seed per Kg.	=	26790
Purity percent	=	89
Germination percent	=	70
Plant percent	=	60

(a) Standard seedling recovery :

= 26790 x .89 x .60

= 14305

(b) Nursery recovery factor :

$$= \frac{60}{70}$$

= .85

(c) Kilogram effective factor :

$$= \frac{14305}{\text{.....A x .....B x ..... C x .85}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{14305}$$

= ..... Kg seed.

---

(24) *Diospyros melenoxylon*

No. of pure seed per Kg.	=	1142
Purity percent	=	100
Germination percent	=	65
Plant percent	=	52

(a) Standard seedling recovery :

= 51850 x 1.0 x .52

= 594

(b) Nursery recovery factor :

$$= \frac{52}{65}$$

= .80

(c) Kilogram effective factor :

$$= \frac{594}{\text{.....A x .....B x ..... C x .80}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{594}$$

= ..... Kg seed.

(25) ***Emblica officinalis***

No. of pure seed per Kg.	=	41330
Purity percent	=	94
Germination percent	=	50
Plant percent	=	15

(a) **Standard seedling recovery :**

= 41330 x .94 x .15

= 5827

(b) **Nursery recovery factor :**

$$= \frac{15}{50}$$

= .30

(c) **Kilogram effective factor :**

$$= \frac{5827}{\text{.....A x .....B x ..... C x .30}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{5827}$$

= ..... Kg seed.

---

(26) ***Eucalyptus camendulensis***

No. of pure seed per Kg.	=	11250000
Purity percent	=	78
Germination percent	=	80
Plant percent	=	8

(a) **Standard seedling recovery :**

= 11250000 x .78 x .08

= 702000

(b) **Nursery recovery factor :**

$$= \frac{8}{80}$$

= .10

(c) **Kilogram effective factor :**

$$= \frac{702000}{\text{.....A x .....B x ..... C x .10}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{702000}$$

= ..... Kg seed.

(27) ***Eucalyptus hybrid***

No. of pure seed per Kg. = 18660000
Purity percent = 76
Germination percent = 77
Plant percent = 20

(a) **Standard seedling recovery :**

= 18660000 x .76 x .20
= 2836320

(b) **Nursery recovery factor :**

$$= \frac{20}{77}$$
= .25

(c) **Kilogram effective factor :**

$$= \frac{2836320}{\text{.....A x .....B x ..... C x .25}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{2836320}$$
= ..... Kg seed.

---

(28) ***Gmelina arborea***

No. of pure seed per Kg. = 1580
Purity percent = 95
Germination percent = 66
Plant percent = 38

(a) **Standard seedling recovery :**

= 1580 x .95 x .38
= 563

(b) **Nursery recovery factor :**

$$= \frac{38}{66}$$
= .57

(c) **Kilogram effective factor :**

$$= \frac{563}{\text{.....A x .....B x ..... C x .57}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{563}$$
= ..... Kg seed.

(29) ***Grevillia pteridifolia***

No. of pure seed per Kg.	=	33115
Purity percent	=	99
Germination percent	=	15
Plant percent	=	4

(a) **Standard seedling recovery :**

= 33115 x .99 x .04

= 1311

(b) **Nursery recovery factor :**

$$= \frac{4}{15}$$

= .26

(c) **Kilogram effective factor :**

$$= \frac{1311}{\text{.....A x .....B x ..... C x .26}} = \text{..... KEF}$$

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{1311} = \text{..... Kg seed.}$$

---

(30) ***Grevillia robusta***

No. of pure seed per Kg.	=	73530
Purity percent	=	98
Germination percent	=	40
Plant percent	=	5

(a) **Standard seedling recovery :**

= 73530 x .98 x .05

= 3603

(b) **Nursery recovery factor :**

$$= \frac{5}{40}$$

= .12

(c) **Kilogram effective factor :**

$$= \frac{3603}{\text{.....A x .....B x ..... C x .12}} = \text{..... KEF}$$

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{3603} = \text{..... Kg seed.}$$

(31) ***Hardwickia binnata***

No. of pure seed per Kg. = 4503
Purity percent = 83
Germination percent = 56
Plant percent = 9

(a) **Standard seedling recovery :**

= 4503 x .83 x .09
= 336

(b) **Nursery recovery factor :**

$$= \frac{9}{56}$$
= .16

(c) **Kilogram effective factor :**

$$= \frac{336}{\text{.....A x .....B x ..... C x .16}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{336}$$
= ..... Kg seed.

---

(32) ***Holoptelia integrifolia***

No. of pure seed per Kg. = 28183
Purity percent = 78
Germination percent = 58
Plant percent = 40

(a) **Standard seedling recovery :**

= 28183 x .78 x .40
= 8793

(b) **Nursery recovery factor :**

$$= \frac{40}{58}$$
= .68

(c) **Kilogram effective factor :**

$$= \frac{8793}{\text{.....A x .....B x ..... C x .68}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{8793}$$
= ..... Kg seed.

(33) ***Jatropha curcus***

No. of pure seed per Kg. = 1784
Purity percent = 96
Germination percent = 68
Plant percent = 35

(a) **Standard seedling recovery :**

= 1784 x .96 x .35
= 599

(b) **Nursery recovery factor :**

$$= \frac{35}{68}$$
= .51

(c) **Kilogram effective factor :**

$$= \frac{599}{\text{.....A x .....B x ..... C x .51}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{599}$$
= ..... Kg seed.

---

(34) ***Lagerstroemia parviflora***

No. of pure seed per Kg. = 49865
Purity percent = 84
Germination percent = 24
Plant percent = 8

(a) **Standard seedling recovery :**

= 49865 x .84 x .08
= 3351

(b) **Nursery recovery factor :**

$$= \frac{8}{24}$$
= .33

(c) **Kilogram effective factor :**

$$= \frac{3351}{\text{.....A x .....B x ..... C x .33}}$$
= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{3351}$$
= ..... Kg seed.

(35) ***Lucaena leucocephala***

No. of pure seed per Kg.	=	23000
Purity percent	=	95
Germination percent	=	78
Plant percent	=	30

(a) Standard seedling recovery :

= 23000 x .95 x .30

= 6555

(b) Nursery recovery factor :

$$= \frac{30}{78}$$

= .38

(c) Kilogram effective factor :

$$= \frac{6555}{\text{.....A x .....B x ..... C x .38}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{6555}$$

= ..... Kg seed.

---

(36) ***Mallotus phillipinensis***

No. of pure seed per Kg.	=	38095
Purity percent	=	98
Germination percent	=	75
Plant percent	=	28

(a) Standard seedling recovery :

= 38095 x .98 x .28

= 10453

(b) Nursery recovery factor :

$$= \frac{28}{75}$$

= .37

(c) Kilogram effective factor :

$$= \frac{10453}{\text{.....A x .....B x ..... C x .37}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{10453}$$

= ..... Kg seed.

(37) ***Mimusops enengi***

No. of pure seed per Kg.	=	1380
Purity percent	=	98
Germination percent	=	70
Plant percent	=	50

(a) Standard seedling recovery :

= 1380 x .98 x .50

= 676

(b) Nursery recovery factor :

$$= \frac{50}{70}$$

= .71

(c) Kilogram effective factor :

$$= \frac{676}{\text{.....A x .....B x ..... C x .71}} = \text{..... KEF}$$

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{676} = \text{..... Kg seed.}$$

---

(38) ***Mitragyana parvifolia***

No. of pure seed per Kg.	=	11500000
Purity percent	=	25
Germination percent	=	46
Plant percent	=	2

(a) Standard seedling recovery :

= 11500000 x .25 x .02

= 57500

(b) Nursery recovery factor :

$$= \frac{2}{46}$$

= .04

(c) Kilogram effective factor :

$$= \frac{57500}{\text{.....A x .....B x ..... C x .04}} = \text{..... KEF}$$

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{57500} = \text{..... Kg seed.}$$

(39) *Pongamia pinnata*

No. of pure seed per Kg.	=	807
Purity percent	=	98
Germination percent	=	63
Plant percent	=	26

(a) **Standard seedling recovery :**

= 807 x .98 x .26

= 205

(b) **Nursery recovery factor :**

$$= \frac{26}{63}$$

= .41

(c) **Kilogram effective factor :**

$$= \frac{205}{\text{.....A x .....B x ..... C x .41}} = \text{..... KEF}$$

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{205} = \text{..... Kg seed.}$$

---

(40) *Prosopis juliflora*

No. of pure seed per Kg.	=	41380
Purity percent	=	82
Germination percent	=	73
Plant percent	=	36

(a) **Standard seedling recovery :**

= 41380 x .82 x .36

= 12216

(b) **Nursery recovery factor :**

$$= \frac{36}{73}$$

= .43

(c) **Kilogram effective factor :**

$$= \frac{12216}{\text{.....A x .....B x ..... C x .43}} = \text{..... KEF}$$

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{12216} = \text{..... Kg seed.}$$

(41) *Pterocarpus marsupium*

No. of pure seed per Kg.	=	2399
Purity percent	=	90
Germination percent	=	40
Plant percent	=	9

(a) Standard seedling recovery :

= 2399 x .90 x .09

= 194

(b) Nursery recovery factor :

$$= \frac{9}{40}$$

= .22

(c) Kilogram effective factor :

$$= \frac{194}{\text{.....A x .....B x ..... C x .22}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{194}$$

= ..... Kg seed.

---

(42) *Putranjiva roxburghii*

No. of pure seed per Kg.	=	1750
Purity percent	=	99
Germination percent	=	14
Plant percent	=	9

(a) Standard seedling recovery :

= 1750 x .99 x .09

= 156

(b) Nursery recovery factor :

$$= \frac{9}{14}$$

= .64

(c) Kilogram effective factor :

$$= \frac{156}{\text{.....A x .....B x ..... C x .64}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{156}$$

= ..... Kg seed.

(43) *Santalum album*

No. of pure seed per Kg.	=	7572
Purity percent	=	95
Germination percent	=	37
Plant percent	=	14

(a) **Standard seedling recovery :**

= 7572 x .95 x .14

= 1007

(b) **Nursery recovery factor :**

$$= \frac{14}{37}$$

= .37

(c) **Kilogram effective factor :**

$$= \frac{1007}{\text{.....A x .....B x ..... C x .37}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{1007}$$

= ..... Kg seed.

---

(44) *Schleichera trijuga*

No. of pure seed per Kg.	=	1710
Purity percent	=	95
Germination percent	=	35
Plant percent	=	14

(a) **Standard seedling recovery :**

= 1710 x .95 x .14

= 227

(b) **Nursery recovery factor :**

$$= \frac{14}{35}$$

= .40

(c) **Kilogram effective factor :**

$$= \frac{227}{\text{.....A x .....B x ..... C x .40}}$$

= ..... KEF

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{\text{..... KEF x 10,000}}{227}$$

= ..... Kg seed.

(45) *Semecarpus anacardium*

No. of pure seed per Kg. = 427
Purity percent = 95
Germination percent = 40
Plant percent = 12

(a) **Standard seedling recovery :**

= 427 x .95 x .12
= 49

(b) **Nursery recovery factor :**

$$= \frac{12}{40}$$
$$= .30$$

(c) **Kilogram effective factor :**

$$= \frac{49}{.....A \times .....B \times ..... C \times .30}$$
$$= ..... KEF$$

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{..... KEF \times 10{,}000}{49}$$
$$= ..... Kg seed.$$

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(46) *Tectona grandis*

No. of pure seed per Kg. = 2172
Purity percent = 95
Germination percent = 49
Plant percent = 28

(a) **Standard seedling recovery :**

= 2172 x .95 x .28
= 578

(b) **Nursery recovery factor :**

$$= \frac{28}{49}$$
$$= .57$$

(c) **Kilogram effective factor :**

$$= \frac{578}{.....A \times .....B \times ..... C \times .57}$$
$$= ..... KEF$$

(d) **Seed weight needed to raise 10,000 seedling :**

$$= \frac{..... KEF \times 10{,}000}{578}$$
$$= ..... Kg seed.$$

(47) *Terminalia arjuna*

No. of pure seed per Kg.	=	522
Purity percent	=	97
Germination percent	=	33
Plant percent	=	14

(a) Standard seedling recovery :

= 522 x .97 x .14

= 71

(b) Nursery recovery factor :

$$= \frac{14}{33}$$

= .42

(c) Kilogram effective factor :

$$= \frac{71}{\text{.....A x .....B x ..... C x .42}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{71}$$

= ..... Kg seed.

---

(48) *Terminalia bellarica*

No. of pure seed per Kg.	=	393
Purity percent	=	90
Germination percent	=	69
Plant percent	=	55

(a) Standard seedling recovery :

= 393 x .90 x .55

= 195

(b) Nursery recovery factor :

$$= \frac{55}{69}$$

= .79

(c) Kilogram effective factor :

$$= \frac{195}{\text{.....A x .....B x ..... C x .79}}$$

= ..... KEF

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{195}$$

= ..... Kg seed.

(49) *Terminalia chebula*

No. of pure seed per Kg.	=	515
Purity percent	=	88
Germination percent	=	55
Plant percent	=	6

(a) Standard seedling recovery :

= 515 x .88 x .06

= 27

(b) Nursery recovery factor :

$$= \frac{6}{55}$$

= .10

(c) Kilogram effective factor :

$$= \frac{27}{\text{.....A x .....B x ..... C x .10}} = \text{..... KEF}$$

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{27}$$

= ..... Kg seed.

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(50) *Terminalia tomentosa*

No. of pure seed per Kg.	=	597
Purity percent	=	98
Germination percent	=	44
Plant percent	=	20

(a) Standard seedling recovery :

= 597 x .98 x .20

= 117

(b) Nursery recovery factor :

$$= \frac{20}{44}$$

= .45

(c) Kilogram effective factor :

$$= \frac{117}{\text{.....A x .....B x ..... C x .45}} = \text{..... KEF}$$

(d) Seed weight needed to raise 10,000 seedling :

$$= \frac{\text{..... KEF x 10,000}}{117}$$

= ..... Kg seed.

CONCLUSION

Raising of sufficient plantable stock is a pre-requisite for the success of any plantation programme. Plants raised in the nurseries have to survive with environmental hazards like insect-pests diseases and unfavourable temperature. All these factors affact quality as well as quantity of planting stock and create uncertainty about availability of required stock to achieve the planting target.

Here it has been concluded on the bases of previous experiences about laboratory testing results and nursery results, that including all nursery recoveries how much seeds are required to raise the given number of seedlings. Before seed sowing a nursery one has to test the seed lot which is being sown. The test results of the lot (A - number of seeds per kg., B-Purity factor and C-Germination factor) may be substituted in the given formula and calculate the kilogram effective factor. This figure may vary from lot to lot. The kilogram effective factor multiplied with the standard figure of the species. In this way the uncertainty of the planting stock can be reduced. The standard figures for various fifty tree species have been concluded in the present study.

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Appendix -1

Standard figures for different 50 tree species

S.N.	Name of Species	No.of Seed per kg.	Purity percent	Germination percent	Plant percent
1.	Acacia auriculiformis	41500	96	52	25
2.	Acacia camplycantha	13500	92	30	10
3.	Acacia catechu	27400	92	70	6
4.	Acacia leucophloea	7600	94	50	20
5.	Acacia nilotica	7132	95	50	25
6.	Adina cordifolia	11000000	35	80	10
7.	Albizzia amara	12855	90	60	25
8.	Albizzia lebbek	8200	80	35	20
9.	Albizzia procera	19150	94	55	27
10.	Anogeissus latifolia	118500	78	6	4
11.	Anogeissus pendula	124350	76	4	2
12.	Anthocephalus kadamba	12300000	36	30	10
13.	Bambusa arundinaceae	70455	87	50	50
14.	Bauhinia malabarica	4350	95	70	65
15.	Bauhinia variegata	4225	94	55	50
16.	Boswelia serrata	17860	94	20	15
17.	Bridelia retusa	5950	96	25	15
18.	Buchnania lanzen	2705	94	75	15
19.	Cassia fistula	6270	93	15	10
20.	Cliestanthus collinus	8500	94	25	12
21.	Dalbergia latifolia	43600	95	80	35
22.	Dalbergia sissoo	51850	91	80	42
23.	Dendrocalamus strictus	26790	89	70	60
24.	Diospyros melanoxylon	1142	100	65	52

25.	Emblica officinalis	41330	94	50	15
26.	Eucalyptus camendulensis	11250000	78	80	8
27.	Eycalyptus hybrid	18660000	76	77	20
28.	Gmelina arborea	1560	95	66	38
29.	Grevillia pteridifolia	33115	99	15	4
30.	Grevillia robusta	73530	98	40	5
31.	Hardwickia binnata	4503	83	56	9
32.	Holoptelia integrifolia	28183	78	58	40
33.	Jatropha curous	1784	96	68	35
34.	Lagerstroemia parviflora	49865	84	24	8
35.	Lucaena leucocephala	23000	95	78	30
36.	Mallotus phillipinensis	38095	98	75	28
37.	Mimusops elengi	1380	98	70	50
38.	Mitragyna parvifolia	11500000	25	46	2
39.	Pongamia pinnata	807	98	63	26
40.	Prosopis juliflora	41380	82	73	36
41.	Pterocarpus marsupium	2399	90	40	9
42.	Putranjiva roxburghii	1750	99	14	9
43.	Santalum album	7572	95	37	14
44.	Schleichera trijuga	1710	95	35	14
45.	Semecarpus anacardium	427	95	40	12
46.	Tectona grandis	2172	95	49	28
47.	Terminalia arjuna	522	97	33	14
48.	Terminalia bellarica	393	90	69	55
49.	Terminalia chebula	515	88	55	6
50.	Terminalia tomentosa	597	98	44	20