CHAPTER 9

Reproductive Potential of Weeds

9.1 Introduction

"Weed" is a great problem in any cultivated field and Tea Gardens are not in exception. In fact, most of these plants are coming from the local vegetation. Weeds cause loss of crop production (Thakur 1954) sometimes to the extent of nearly 90% of expectation. These plants create or modify the habitat in such a manner which does not favour the proper growth of crop plants by utilizing space and nutrients for their own growth. Like all other crops, Tea Gardens also greatly affected by weeds and causing qualitative and quantitative loss of the crop (Mustafee 1981, 1998).

Life of the individual plant is limited in duration; it has developed certain mechanisms by which it can reproduce itself in order to continue the perpetuation of the species and also to multiply in number to create a larger population structure. The mechanism of propagation of weeds are numerous and a full understanding of their various aspects is essential if one is to cope with a specific weed problem and to strike at one of the most vital aspects of weed growth – the spread into new habitat (King 1966). The primary survival mechanisms of weeds are seeds, rhizomes, stolons, roots, tubers, buds, bulbs, bulblets etc. Seed production is the method by which weeds are most widely disseminated. Thus seed production, seed dissemination, dormancy and ability of seeds and propagules to resist any detrimental effects of the environment are the major adaptations for survival of weeds.

The crop field weeds adapted to grow in a habitat with frequent disturbances in the soil mainly due to different agronomic practices. Annuals are, therefore, the prevailing life forms among the weeds. These are mainly therophytes, i.e. they reproduce by seeds. Most of the weeds are herbaceous and success of a weed is greatly depending on its ability for viable seed production. To control those weeds, it is therefore very important to know the reproductive potentiality of these weeds, which mainly include the health and number of seeds, seed weight, viability, germination, mode of dispersal etc. The reproductive capacity, which are certainly genetically controlled, are very much species specific and is of considerable ecological interest. Reproductive capacity also has bearing on the dispersal of seeds.

9.1.1 What is a Seed?

A seed has been defined as a "matured integumented ovule" but a slightly more elaborate definition describes the seed as "a reproductive unit formed from a fertilized ovule, consisting of an embryo, food store and protective coat". Weeds produce large number of seeds, which have greater viability than crop seeds. A single individual of a weed species commonly produces a very large number of seeds, tens and hundreds of thousands and these seeds easily escape detection when scattered on or within the soil, making their presence known only as and when they germinate and become seedlings of plants. Seed germination is accomplished if the seed passes through three stages viz. imbibation of water, activation of the metabolic processes leading to mobilization and translocation of nutrient reserves as well as synthesis of new structural and enzymatic constituents and the growth of embryo. Blocking any of these three stages resulted in the dormancy of seeds.

In angiosperms the adaptive significance of seeds is associated with the reproductive efficiency and successful establishment of seedlings in nature (Stebbeins, 1971). Due to the above fact, the resources available to a plant during development are divided between seed production and other ends so that the allocation of seeds is itself partitioned between numbers and size (Harper, 1970). The high seed number and small seed size confers an increased chance for dispersal. Accordingly, some seeds will land in

a spot that is favorable for seed germination and seedling establishment. Larger seed numbers enhances the chances that some seeds will find a 'safe site' (Harper, 1965). So, it is necessary to gather some knowledge about the number of seeds produced by a plant and also the seed weight, to understand its reproductive potential. Though many of these seeds are consumed, destroyed or wasted in nature in various ways, but both seed weight and seed number contributes to the establishment of a weed species. The actual number varies with the species and environmental conditions. The number of seeds produced per plant is related apparently to the total weight of the seeds produced and the lighter and smaller the seeds the more seeds are produced per plant. Production of abundant and small seeds is a common adaptation that ensures a high probability of dispersal and re-infestation. Annual and biennial weeds depend on seed production as the means of propagation and survival while perennial weeds are less dependent on this mechanism and the persistence of annual and biennial weeds depend mainly on their ability to re-infest the soil. In cultivated fields annual weeds also arise from seeds lying buried in the soil, a legacy of preceding weed flora in the same piece of land. Cultivated land becomes a reservoir for vast number of viable weed seeds ranging in numbers from a few million to well over 100 million per acre. The first infestation of most perennial species begins largely with seeds. A single plant of an annual weed can produce enough seeds in one season to cover an entire area of one acre with this species in the next year. Many weeds can produce large number of viable seeds even after having cut off soon after flowering. A few weeds may produce seeds through apomixes and weeds like fern and fern allies reproduce by spores. If the production of seeds can be controlled, many species eventually can be eliminated from the crop fields. In widely distributed plant population of the cosmopolitan species, the adaptational features are sometimes correlated with specific environmental characters and the plants occurring under those specific conditions differ in shape, size, colour, growth habit, reproductive behavior and vigor etc. from the other plants of the same species growing in nature (Misra, 1974).

9.2 Previous Works

Weed related literature contains numerous references to seed size, seed shape, seed morphology, seed weight, seed germination, seed output as well as reproductive

capacity. Stone (1914) listed the weed seed contents in crop seed samples. Korsmo (1930) provided considerable information on the weight and number of seed per plant. Stevens (1932, 1957) presented valuable data on the seed production of common weeds & economic plants with special reference to the selection of specimens & clearing of seed material according to a definite plan. Hofslen (1954) reported that in extreme cases seed output/hectare might exceed one million. Salisbury (1942) noted that high seed production is the characteristic feature of a species that is associated with the colonisation of weeds in a new habitat, such as woodland clearings, mud of shallow lakes and ponds etc. The average seed output of as many as 32 species studied showed 2,27,000 seeds per plant

Black (1956, 1959) pointed out the influence and variation in seed size. Baker (1972) presented the seed weight in relation to environmental conditions. Harper (1970) presented valuable information on the shapes and sizes of seeds. Holm *et al* (1977) also counted the seeds of many weed species. In India, Tadulingam & Venkatnarayana (1932) described the seed morphology of several South Indian weeds. Datta *et al* (1970) and Ghosh & Datta (1975) described the seed morphology of some species of *Corchorus*. Maity & Banerjee (1976) described the exomorphic seed structure but they did not provide any information of seed out put per plant. But, Datta & Banerjee (1976) recorded the weight of 1000 seeds and total seed number for 140 weeds prevailing in rice fields of West Bengal. They also compared the seed production of three common species with those published by Pammel & King (1910), Ottawa Laboratory (1929), Korsmo (1930) and Stevens (1932, 1957). Datta *et al* (1980) recorded the weight of 1000 seeds as well as total number of seeds produced by a plant for 66 Indian weeds. Paria & Sahoo (1981) reported the reproductive capacity of certain weed species growing in the vicinity of Calcutta. Islam (1996) worked on the shapes, sizes and weights of seeds as well as the average seed output of common weeds of North - East India. Acharya (1998) recorded the weights of 1000 seeds as well as total number of seeds produced by a plant for 130 rice field weeds of Malda district. Laloo (2003) determined the germination percentage, average seed output and finally the reproductive capacity of some common and dominant weed species of Meghalaya.

9.3 The Present Work

There was no other available previous work on the reproductive potential of weeds of Darjiling District. Present dissertation is an attempt to know the vegetation properly, and reproductive potentiality of some common Tea Garden weeds of this region. Present work may add little but important and essential knowledge on the weeds of Darjiling District. This will be also helpful in realizing the influence of habitat factors on the reproductive potential of different weeds, if such a comparison is made in future.

9.4 Results & Discussion:

During the study of "Reproductive Potential" five aspects of angiospermic Tea Garden weeds of the Darjiling District has been taken into consideration. These are (a) number of seeds per fruit, (b) number of seeds per plant, (c) weight of 1000 seeds, (d) germination percentage and (e) Reproductive capacity.

A total of 80 species has been selected from tea gardens of Terai region only and worked out for this purpose. In case of germination, all set-ups were done in laboratory conditions under diffused light for a short period of ten days only. Though, it is true that weed-seeds can remain dormant in soil for months together even under favorable environmental conditions. All the observations have been presented below in Tables 9.1 and 9.2.

Table 9.1: Seed Size Index, Shape Index and Seed Weight of common Tea weeds of Terai and Hills of Darjiling. [In Asteraceae the number of cypsela has been considered as number of seeds]

Sl. No.	Name of plants	Family	Length (mm)	Breadth (mm)	Size index	Shape index	Weight of seeds (g)	
							1 seed	1000 seeds
1	*Acalypha indica*	Euphorbiaceae	1	0.8	0.8	1.25	0.000109	0.109
2	*Acmella paniculata*	Asteraceae	2	1	2	2	0.000133	0.133
3	*Ageratum conyzoides*	Asteraceae	3	0.25	0.75	12	0.000099	0.099
4	*Ageratum houstonianum*	Asteraceae	3.5	0.3	1.05	11.67	0.001964	1.964
5	*Amaranthus spinosus*	Amaranthaceae	1	1	1	1	0.000215	0.215
6	*Amaranthus viridis*	Amaranthaceae	1	1	1	1	0.000261	0.261

7	*Anisomeles indica*	Lamiaceae	2	1.5	3	1.33	0.00138	1.38
8	*Bidens pilosa*	Asteraceae	9	0.5	4.5	18	0.001354	1.354
9	*Blumea lacera*	Asteraceae	2.5	0.2	0.5	12.5	0.000039	0.039
10	*Borreria alata*	Rubiaceae	3	1.5	4.5	2	0.002949	2.949
11	*Borreria ocymoides*	Rubiaceae	1	0.3	0.3	3.33	0.000086	0.086
12	*Cassia occidentalis*	Caesalpinaceae	6	3	18	2	0.015809	15.809
13	*Cassia tora*	Caesalpinaceae	4	3.5	14	1.14	0.020457	20.457
14	*Centella asiatica*	Apiaceae	3	2	6	1.5	0.000575	0.575
15	*Chromolaena odoratum*	Asteraceae	10	0.5	5	20	0.000283	0.283
16	*Chrysopogon aciculatus*	Poaceae	2.5	0.2	0.5	12.5	0.000572	0.572
17	*Cleome rutidosperma*	Capparaceae	1.9	1.5	2.85	1.27	0.000907	0.907
18	*Clerodendrum viscosum*	Verbenaceae	7	6	42	1.17	0.047199	47.199
19	*Conyza canadensis*	Asteraceae	1.5	0.25	0.38	6	0.00004	0.04
20	*Crassocephalum crepidioides*	Asteraceae	11	6	66	1.83	0.000303	0.303
21	*Crotalaria pallida*	Fabaceae s.s.	3	2	6	1.5	0.010762	10.762
22	*Croton bonplandianus*	Euphorbiaceae	4.5	2.1	9.45	2.14	0.007083	7.083
23	*Cyanthillium cinereum*	Asteraceae	6	0.5	3	12	0.00014	0.14
24	*Cynoglossum lanceolatum*	Boraginaceae	2	2	4	1	0.001059	1.059
25	*Cyperus compressus*	Cyperaceae	1	0.5	0.5	2	0.000126	0.126
26	*Cyperus cyperoides*	Cyperaceae	1	1	1	1	0.00012	0.12
27	*Cyperus tenuispica*	Cyperaceae	0.4	0.3	0.12	1.33	0.000048	0.048
28	*Drymaria diandra*	Caryophyllaceae	0.9	0.6	0.54	1.5	0.000203	0.203
29	*Eclipta prostrata*	Asteraceae	2	1	2	2	0.000288	0.288
30	*Elephantopus scaber*	Asteraceae	4.4	0.6	2.64	7.33	0.000587	0.587
31	*Emilia sonchifolia*	Asteraceae	8.5	0.5	4.25	17	0.000304	0.304
32	*Eragrostis tenella*	Poaceae	0.5	0.3	0.15	1.67	0.00002	0.02
33	*Euphorbia hirta*	Euphorbiaceae	0.5	0.5	0.25	1	0.000057	0.057
34	*Euphorbia orbiculata*	Euphorbiaceae	1	0.5	0.5	2	0.000332	0.332
35	*Fimbristylis dichotoma*	Cyperaceae	0.5	0.5	0.25	1	0.000049	0.049
36	*Gamochaeta pensylvanicum*	Asteraceae	0.4	0.1	0.04	4	0.000007	0.007
37	*Glinus lotoides*	Molluginaceae	0.2	0.1	0.02	2	0.000007	0.007
38	*Glinus oppositifolius*	Molluginaceae	0.2	0.2	0.04	1	0.000022	0.022
39	*Heliotropium indicum*	Boraginaceae	1.5	1	1.5	1.5	0.001682	1.682
40	*Hydrocotyle sibthorpioides*	Apiaceae	1	0.8	0.8	1.25	0.000146	0.146
41	*Hypericum japonicum*	Hypericaceae	0.4	0.1	0.04	4	0.000006	0.006
42	*Hyptis suaveolens*	Lamiaceae	3.1	2.2	6.82	1.41	0.004013	4.013
43	*Ipomoea quamoclit*	Convolvulaceae	6	3	18	2	0.0124	12.4
44	*Kyllinga nemoralis*	Cyperaceae	1.25	0.75	0.94	1.67	0.000147	0.147
45	*Leucas indica*	Lamiaceae	3	1	3	3	0.001218	1.218
46	*Lindernia crustacea*	Scrophulariaceae	0.2	0.2	0.04	1	0.00025	0.25
47	*Ludwigia perennis*	Onagraceae	0.5	0.5	0.25	1	0.00002	0.02
48	*Mazus pumilus*	Scrophulariaceae	0.3	0.2	0.06	1.5	0.00008	0.08
49	*Melastoma malabathricum*	Melastomataceae	0.5	0.5	0.25	1	0.000004	0.004
50	*Melochia corchorifolia*	Sterculiaceae	2.3	1.8	4.14	1.28	0.004443	4.443
51	*Mitracarpus verticillatus*	Rubiaceae	0.9	0.5	0.45	1.8	0.000134	0.134

52	*Oldenlandia corymbosa*	Rubiaceae	0.25	0.25	0.06	1	0.000013	0.013
53	*Oldenlandia diffusa*	Rubiaceae	0.25	0.25	0.06	1	0.00002	0.02
54	*Osbeckia nepalensis*	Melastomataceae	0.75	0.5	0.375	1.5	0.000025	0.025
55	*Oxalis corniculata*	Oxalidaceae	1.2	1	1.2	1.2	0.000608	0.608
56	*Paspalum scrobiculatum*	Poaceae	2	1.5	3	1.33	0.000778	0.778
57	*Peperomia pellucida*	Piperaceae	0.5	0.5	0.25	1	0.000114	0.114
58	*Persicaria orientalis*	Polygonaceae	2	2	4	1	0.002875	2.875
59	*Phaulopsis imbricata*	Acanthaceae	2	1.9	3.8	1.05	0.000577	0.577
60	*Phyllanthus urinaria*	Euphorbiaceae	1.25	0.75	0.94	1.67	0.000296	0.296
61	*Plantago erosa*	Plantaginaceae	1	0.7	0.7	1.43	0.000132	0.132
62	*Polycarpon prostratum*	Caryophyllaceae	0.5	0.5	0.25	1	0.000032	0.032
63	*Polygonum plebeium*	Polygonaceae	1.2	1	1.2	1.2	0.000392	0.392
64	*Pouzolzia zeylanica*	Urticaceae	1.2	0.8	0.96	1.5	0.000264	0.264
65	*Pseudognaphalium affine*	Asteraceae	0.3	0.1	0.03	3	0.0028	2.8
66	*Pupalia lappacea*	Amaranthaceae	2.5	1	2.5	2.5	0.002349	2.349
67	*Richardia scabra*	Rubiaceae	2.5	1.8	4.5	1.39	0.001109	1.109
68	*Scoparia dulcis*	Scrophulariaceae	0.2	0.25	0.05	0.8	0.00001	0.01
69	*Setaria pumila*	Poaceae	1	0.5	0.5	2	0.000148	0.148
70	*Sida acuta*	Malvaceae	2	1.9	3.8	1.05	0.002144	2.144
71	*Solanum aculeatissimum*	Solanaceae	2.9	2	5.8	1.45	0.002983	2.983
72	*Solanum nigrum*	Solanaceae	1.8	1	1.8	1.8	0.00056	0.56
73	*Solanum torvum*	Solanaceae	3	2	6	1.5	0.00167	1.67
74	*Stellaria media*	Caryophyllaceae	1	0.8	0.8	1.25	0.000205	0.205
75	*Synedrella nodiflora*	Asteraceae	7	1	7	7	0.000747	0.747
76	*Tephrosia candida*	Fabaceae s.s.	5	4.2	21	1.19	0.00942	9.42
77	*Tridax procumbens*	Asteraceae	7	1	7	7	0.000683	0.683
78	*Triumfetta rhomboidea*	Tiliaceae	4	4	16	1	0.00507	5.07
79	*Urena lobata*	Malvaceae	3.5	2.5	8.75	1.4	0.01294	12.94
80	*Youngia japonica*	Asteraceae	6	0.5	3	12	0.000083	0.083

Table 9.2: Seed Out-put of some common Tea weeds of Terai and Hills of Darjiling. [In Asteraceae the number of cypsela has been considered as number of seeds].

Sl. No.	Name of plants	Seed Output			Reproductive capacity			
		Fruit or capitula / plant	Seeds / Fruit	Seed Output	Germi-nation %	Viable %	Non-viable %	RC Value
1	*Acalypha indica*	177	3	531	*	*	*	*
2	*Acmella paniculata*	124	166	20584	7	7	93	1440.88
3	*Ageratum conyzoides*	155	97	15035	7	7	93	1052.45
4	*Ageratum houstonianum*	380	89	33820	24	24	76	8116.8
5	*Amaranthus spinosus*	2580	1	2580	6	6	94	154.8
6	*Amaranthus viridis*	1841	1	1841	1	1	99	18.41
7	*Anisomeles indica*	119	4	476	*	*	*	*

8	*Bidens pilosa*	85	53	4505	32	32	68	1441.6
9	*Blumea lacera*	374	233	87142	*	*	*	*
10	*Borreria alata*	339	2	678	29	29	71	196.62
11	*Borreria ocymoides*	375	2	750	*	*	*	*
12	*Cassia occidentalis*	63	38	2394	70	70	30	1675.8
13	*Cassia tora*	214	50	10700	93	93	7	9951
14	*Centella asiatica*	39	2	78	*	*	*	*
15	*Chromolaena odoratum*	133	37	4921	13	13	87	639.73
16	*Chrysopogon aciculatus*	76	1	76	80	80	20	60.8
17	*Cleome rutidosperma*	43	51	2193	1	1	99	21.93
18	*Clerodendrum viscosum*	84	3	252	*	*	*	*
19	*Conyza canadensis*	7378	120	885360	8	8	92	70828.8
20	*Crassocephalum crepidioides*	63	170	10710	16	16	84	1713.6
21	*Crotalaria pallida*	278	47	13066	30	30	70	3919.8
22	*Croton bonplandianus*	875	3	2625	*	*	*	*
23	*Cyanthillium cinereum*	330	24	7920	59	59	41	4672.8
24	*Cynoglossum lanceolatum*	3523	4	14092	*	*	*	*
25	*Cyperus compressus*	10388	1	10388	*	*	*	*
26	*Cyperus cyperoides*	13566	1	13566	*	*	*	*
27	*Cyperus tenuispica*	149	1	149	*	*	*	*
28	*Drymaria diandra*	349	6	2094	12	12	88	251.28
29	*Eclipta prostrata*	42	99	4158	34	34	66	1413.72
30	*Elephantopus scaber*	5	68	340	12	12	88	40.8
31	*Emilia sonchifolia*	172	43	7396	59	59	41	4363.64
32	*Eragrostis tenella*	2044	1	2044	*	*	*	*
33	*Euphorbia hirta*	283	3	849	1	1	99	8.49
34	*Euphorbia orbiculata*	231	3	693	*	*	*	*
35	*Fimbristylis dichotoma*	232	1	232	*	*	*	*
36	*Gamochaeta pensylvanicum*	68	72	4896	8	8	92	391.68
37	*Glinus lotoides*	311	58	18038	*	*	*	*
38	*Glinus oppositifolius*	47	77	3619	*	*	*	*
39	*Heliotropium indicum*	836	4	3344	*	*	*	*
40	*Hydrocotyle sibthorpioides*	2369	2	4738	*	*	*	*
41	*Hypericum japonicum*	10	221	2210	*	*	*	*
42	*Hyptis suaveolens*	1145	2	2290	98	98	2	2244.2
43	*Ipomoea quamoclit*	666	4	2664	12	12	88	319.68
44	*Kyllinga nemoralis*	4864	1	4864	5	5	95	243.2
45	*Leucas indica*	1025	4	4100	*	*	*	*
46	*Lindernia crustacea*	61	130	7930	*	*	*	*
47	*Ludwigia perennis*	288	1520	437760	*	*	*	*
48	*Mazus pumilus*	55	217	11935	*	*	*	*
49	*Melastoma malabathricum*	102	997	101694	14	14	86	14237.16
50	*Melochia corchorifolia*	34	5	170	80	80	20	136

51	*Mitracarpus verticillatus*	2439	2	4878	3	3	97	146.34
52	*Oldenlandia corymbosa*	134	59	7906	3	3	97	237.18
53	*Oldenlandia diffusa*	82	76	6232	3	3	97	186.96
54	*Osbeckia nepalensis*	244	580	141520	72	72	28	101894.4
55	*Oxalis corniculata*	31	43	1333	*	*	*	*
56	*Paspalum scrobiculatum*	710	1	710	1	1	99	7.1
57	*Peperomia pellucida*	2600	1	2600	*	*	*	*
58	*Persicaria orientalis*	4557	1	4557	1	1	99	45.57
59	*Phaulopsis imbricata*	233	4	932	64	64	36	596.48
60	*Phyllanthus urinaria*	1720	6	10320	*	*	*	*
61	*Plantago erosa*	1511	17	25687	1	1	99	256.87
62	*Polycarpon prostratum*	101	13	1313	*	*	*	*
63	*Polygonum plebeium*	1150	1	1150	*	*	*	*
64	*Pouzolzia zeylanica*	425	1	425	42	42	58	178.5
65	*Pseudognaphalium affine*	121	105	12705	7	7	93	889.35
66	*Pupalia lappacea*	13192	1	13192	97	97	3	12796.24
67	*Richardia scabra*	350	3	1050	*	*	*	*
68	*Scoparia dulcis*	658	223	146734	8	8	92	11738.72
69	*Setaria pumila*	141	1	141	48	48	52	67.68
70	*Sida acuta*	113	4	452	8	8	92	36.16
71	*Solanum aculeatissimum*	34	337	11458	*	*	*	*
72	*Solanum nigrum*	290	54	15660	4	4	96	626.4
73	*Solanum torvum*	7	225	1575	*	*	*	*
74	*Stellaria media*	267	18	4806	8	8	92	384.48
75	*Synedrella nodiflora*	185	18	3330	50	50	50	1665
76	*Tephrosia candida*	289	10	2890	62	62	38	1791.8
77	*Tridax procumbens*	20	44	880	36	36	64	316.8
78	*Triumfetta rhomboidea*	127	1	127	8	8	92	10.16
79	*Urena lobata*	38	5	190	20	20	80	38
80	*Youngia japonica*	156	23	3588	8	8	92	287.04

9.4.1 Species-wise Observation

As Dicotylodonous plants are dominating in the weed flora, a larger number of 71 species of this group has been tested with only nine species of monocots. The findings on fruit and seed output, germination percentage and reproductive capacity of the selected weed species have been summarized in Tables 9.1 & 9.2 and has been described below in detail:

I. DICOTS:

***Acalypha indica* L.:** The average number of fruits produced by an individual of this species is 177, and 3 seeds in one fruit. So the average seed-output is 531. No

germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Acmella paniculata* (DC.) Jansen:** The average number of fruits produced by an individual of this species is 124, and 166 seeds in one fruit. This brought the average seed-output of the species to 20584. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 7% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1440.88 per plant.

***Ageratum conyzoides* L.:** The average number of capitula produced by an individual of this species is 155, and 97 cypsela in one capitulum. This brought the average seed-output of the species to 15035. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 7% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1052.45 per plant.

***Ageratum houstonianum* Milller:** The average number of capitula produced by an individual of this species is 380, and 89 cypsela in one capitulum. This brought the average seed-output of the species to 33820. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 24% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 8116.8 per plant.

***Amaranthus spinosus* L.:** The average number of fruits produced by an individual of this species is 2580, and 1 seed in one fruit. This brought the average seed-output of the species to 2580. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 6% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 154.8 per plant.

***Amaranthus viridis* L.:** The average number of fruits produced by an individual of this species is 1841, and 1 seed in one fruit. This brought the average seed-output of the species to1841. In the absence of light, germination started from the 10th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 18.41 per plant.

***Anisomeles indica* (L.) O.Kuntze:** The average number of fruits produced by an individual of this species is 119, and 4 seeds in one fruit. This brought the average seed-output of the species to 476. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Bidens pilosa* L.:** The average number of capitula produced by an individual of this species is 85, and 53 cypsela in one capitulum. This brought the average seed-output of the species to 4505. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 32% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1441.6. per plant.

***Blumea lacera* (Burm.f.) DC.:** The average number of capitula produced by an individual of this species is 374, and 233 cypsela in one capitulum. This brought the average seed-output of the species to 87142. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Borreria alata* (Aubl.) DC.:** The average number of fruits produced by an individual of this species is 339, and 2 seeds in one fruit. This brought the average seed-output of the species to 678. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 29% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 196.62 per plant.

***Borreria ocymoides* (Burm.f.) DC.:** The average number of fruits produced by an individual of this species is 375, and 2 seeds in one fruit. This brought the average seed-output of the species to 750. In the absence of light, no germination was observed. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Cassia occidentalis* L.:** The average number of fruits produced by an individual of this species is 63, and 38 seeds in one fruit. This brought the average seed-output of the species to 2394. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 70% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1675.8 per plant.

***Cassia tora* L.:** The average number of fruits produced by an individual of this species is 214, and 50 seeds in one fruit. This brought the average seed-output of the species to10700. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 93% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 9951 per plant.

***Centella asiatica* (L.) Urban:** The average number of fruits produced by an individual of this species is 39, and 2 seeds in one fruit. This brought the average seed-output of the species to 78. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Chromolaena odoratum* (L.) King& Robinson:** The average number of capitula produced by an individual of this species is 133, and 37 cypsela in one capitulum. This brought the average seed-output of the species to 4921. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 13% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 639.73 per plant.

***Cleome rutidosperma* DC.:** The average number of fruits produced by an individual of this species is 43, and 51 seeds in one fruit. This brought the average seed-output of the species to 2193. In the absence of light, germination started from the 7th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 21.93 per plant.

***Clerodendrum viscosum* Ventenat:** The average number of fruits produced by an individual of this species is 84, and 3 seeds in one fruit. This brought the average seed-output of the species to 252. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Conyza canadensis* (L.) Cronquist:** The average number of capitula produced by an individual of this species is 7378, and 120 seeds in one fruit. This brought the average seed-output of the species to 885360. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 70828.8 per plant.

***Crassocephalum crepidioides* (Bentham) S. Moore:** The average number of capitula produced by an individual of this species is 63, and 170 cypsela in one capitulum. This brought the average seed-output of the species to 10710. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 16 % germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1713.6 per plant.

***Crotalaria pallida* Aiton:** The average number of fruits produced by an individual of this species is 278, and 47 seeds in one fruit. This brought the average seed-output of the species to13066. In the absence of light, germination started from the 3rd day and made a

steady progress up to 10th day. On the 10th day, 30% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 3919.8 per plant.

***Croton bonplandianus* Baillon:** The average number of fruits produced by an individual of this species is 875, and 3 seeds in one fruit. This brought the average seed-output of the species to 2625. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Cyanthillium cinereum* (L.) Robinson:** The average number of capitula produced by an individual of this species is 330, and 24 cypsela in one capitulum. This brought the average seed-output of the species to 7920. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 59% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 4672.8 per plant.

***Cynoglossum lanceolatum* Forsskal:** The average number of fruits produced by an individual of this species is 3523, and 4 seeds in one fruit.. This brought the average seed-output of the species to 14092. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Drymaria diandra* (Blume) Duke:** The average number of fruits produced by an individual of this species is 349, and 6 seeds in one fruit. This brought the average seed-output of the species to 2094. In the absence of light, germination started from the 6th day and made a steady progress up to 10th day. On the 10th day, 12% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 251.28 per plant.

***Eclipta prostrata* (L.) L.:** The average number of capitula produced by an individual of this species is 42, and 99 cypsela in one capitulum. This brought the average seed-output

of the species to 4158. In the absence of light, germination started from the 6th day and made a steady progress up to 10th day. On the 10th day, 34% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1413.72per plant.

***Elephantopus scaber* L.:** The average number of capitula produced by an individual of this species is 5, while the number of seeds in one fruit was 68. This brought the average seed-output of the species to 340. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 12% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 40.8 per plant.

***Emilia sonchifolia* (L.) DC.:** The average number of capitula produced by an individual of this species is 172, and 43 cypsela in one capitulum. This brought the average seed-output of the species to 7396. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 59% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 4363.64 per plant.

***Eragrostis tenella* (L.) P. Beauvois ex Roemer & Schultes.:** The average number of fruits produced by an individual of this species is 2044, and 1 seed in one fruit This brought the average seed-output of the species to 2044. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Euphorbia hirta* L.:** The average number of fruits produced by an individual of this species is 283, and 3 seeds in one fruit.. This brought the average seed-output of the species to 849. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 8.49 per plant.

***Euphorbia orbiculata* H. B. K.:** The average number of fruits produced by an individual of this species is 231, and 3 seeds in one fruit.. This brought the average seed-output of the species to 693. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Gamochaeta pensylvanicum* (Willdenow) Cabrera:** The average number of capitula produced by an individual of this species is 68, and 72 seeds in one fruit. This brought the average seed-output of the species to 4896. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 391.68 per plant.

***Glinus lotoides* L.:** The average number of fruits produced by an individual of this species is 311, and 58 seeds in one fruit. This brought the average seed-output of the species to 18038. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Glinus oppositifolius* (L.) A. DC.:** The average number of fruits produced by an individual of this species is 47, and 77 seeds in one fruit. This brought the average seed-output of the species to 3619. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Heliotropium indicum* L.:** The average number of fruits produced by an individual of this species is 836, and 4 seeds in one fruit. This brought the average seed-output of the species to 3344. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Hydrocotyle sibthorpioides* Lam.:** The average number of fruits produced by an individual of this species is 2369, and 2 seeds in one fruit. This brought the average seed-output of the species to 4738. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Hypericum japonicum* Murray:** The average number of fruits produced by an individual of this species is 10, and 221 seeds in one fruit. This brought the average seed-output of the species to 2210. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Hyptis suaveolens* (L.) Poiteau.:** The average number of fruits produced by an individual of this species is 1145, and 2 seeds in one fruit. This brought the average seed-output of the species to 2290. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 98% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 2244.2 per plant.

***Ipomoea quamoclit* L.:** The average number of fruits produced by an individual of this species is 666, and 4 seeds in one fruit. This brought the average seed-output of the species to 2664. In the absence of light, germination started from the 1st day and made a steady progress up to 10th day. On the 10th day, 12% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 319.68 per plant.

***Leucas indica* (L.) R. Br. ex Vatke:** The average number of fruits produced by an individual of this species is 1025, and 4 seeds in one fruit. This brought the average seed-output of the species to 4100. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Lindernia crustacea* (L.) Mueller:** The average number of fruits produced by an individual of this species is 61, and 130 seeds in one fruit. This brought the average seed-output of the species to 7930. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Ludwigia perennis* L.:** The average number of fruits produced by an individual of this species is 288, and 1520 seeds in one fruit. This brought the average seed-output of the

species to 437760. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Mazus pumilus* (Burman f.) van Steenis:** The average number of fruits produced by an individual of this species is 55, and 217 seeds in one fruit. This brought the average seed-output of the species to 11935. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Melastoma malabathricum* L.:** The average number of fruits produced by an individual of this species is 102, and 997 seeds in one fruit. This brought the average seed-output of the species to 101694. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 14% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, 14237.16 was per plant.

***Melochia corchorifolia* L.:** The average number of fruits produced by an individual of this species is 34, and 5 seeds in one fruit. This brought the average seed-output of the species to 170. In the absence of light, germination started from the 7th day and made a steady progress up to 10th day. On the 10th day, 80% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 136 per plant.

***Mitracarpus verticillatus* (Schum. et Thonn.) Vatke:** The average number of fruits produced by an individual of this species is 2439, and 2 seeds in one fruit. This brought the average seed-output of the species to 4878. In the absence of light, germination started from the 9th day and made a steady progress up to 10th day. On the 10th day, 3% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 146.34 per plant.

***Oldenlandia corymbosa* L.:** The average number of fruits produced by an individual of this species is 134, and 59 seeds in one fruit. This brought the average seed-output of the

species to 7906. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 3% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 237.18 per plant.

***Oldenlandia diffusa* (Willdenow) Roxburgh:** The average number of fruits produced by an individual of this species is 82, and 76 seeds in one fruit. This brought the average seed-output of the species to 6232. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 3% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 186.96 per plant.

***Osbeckia nepalensis* Hooker:** The average number of fruits produced by an individual of this species is 244, and 580 seeds in one fruit. This brought the average seed-output of the species to 141520. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 72% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 101894.4 per plant.

***Oxalis corniculata* L.:** The average number of fruits produced by an individual of this species is 31, and 43 seeds in one fruit. This brought the average seed-output of the species to 1333. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Peperomia pellucida* (L.) Kunth:** The average number of fruits produced by an individual of this species is 2600, and 1 seed in one fruit. This brought the average seed-output of the species to 2600. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Persicaria orientalis* (L.) Spach:** The average number of fruits produced by an individual of this species is 4557, and 1 seed in one fruit. This brought the average seed-output of

the species to 4557. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 45.57 per plant.

***Phaulopsis imbricata* (Forsskal) Sweet:** The average number of fruits produced by an individual of this species is 233, and 4 seeds in one fruit. This brought the average seed-output of the species to 932. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 64% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 596.48 per plant.

***Phyllanthus urinaria* L.:** The average number of fruits produced by an individual of this species is 1720 and 6 seeds in one fruit. This brought the average seed-output of the species to 10320. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Plantago erosa* Wallich:** The average number of fruits produced by an individual of this species is 1511 and 17 seeds in one fruit. This brought the average seed-output of the species to 25687. In the absence of light, germination started from the 8th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 256.87per plant.

***Polycarpon prostratum* (Forsskal) Ascherson:** The average number of fruits produced by an individual of this species is 101 and 13 seeds in one fruit. This brought the average seed-output of the species to 1313. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Polygonum plebeium* R. Brown:** The average number of fruits produced by an individual of this species is 1150 and 1 seed in one fruit. This brought the average seed-output of the species to 1150. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Pouzolzia zeylanica* (L.) Bennett:** The average number of fruits produced by an individual of this species is 425 and 1 seed in one fruit. This brought the average seed-output of the species to 425. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 42% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 178.5 per plant.

***Pseudognaphalium affine* (D. Don) Anderberg:** The average number of capitula produced by an individual of this species is 121 and 105 seeds in one fruit. This brought the average seed-output of the species to 12705. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 7% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 889.35 per plant.

***Pupalia lappacea* (L.) Juss.:** The average number of fruits produced by an individual of this species is 13192 and 1 seed in one fruit. This brought the average seed-output of the species to 13192. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 97% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 12796.24 per plant.

***Richardia scabra* L.:** The average number of fruits produced by an individual of this species is 350 and 3 seeds in one fruit. This brought the average seed-output of the species to 1050. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Scoparia dulcis* L.:** The average number of fruits produced by an individual of this species is 658 and 223 seeds in one fruit. This brought the average seed-output of the species to 146734. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 11738.72 per plant.

***Sida acuta* Burm.f.:** The average number of fruits produced by an individual of this species is 113 and 4 seeds in one fruit. This brought the average seed-output of the species to 452. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 36.16 per plant.

***Solanum aculeatissimum* Jacquin:** The average number of fruits produced by an individual of this species is 34 and 337 seeds in one fruit. This brought the average seed-output of the species to 11458. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Solanum nigrum* L.:** The average number of fruits produced by an individual of this species is 290 and 54 seeds in one fruit. This brought the average seed-output of the species to 15660. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 4% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 626.4 per plant.

***Solanum torvum* Swartz:** The average number of fruits produced by an individual of this species is 7 and 224 seeds in one fruit. This brought the average seed-output of the species to 1575. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Stellaria media* (L.) Villars.:** The average number of fruits produced by an individual of this species is 267 and 18 seeds in one fruit. This brought the average seed-output of the species to 4806. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 384.48 per plant.

***Synedrella nodiflora* (L.) Gaertner.:** The average number of capitula produced by an individual of this species is 185 and 18 cypsela in one capitulum This brought the average seed-output of the species to 3330. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 50% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1665 per plant.

***Tephrosia candida* DC.:** The average number of fruits produced by an individual of this species is 289 and 10 seeds in one fruit. This brought the average seed-output of the species to 2890. In the absence of light, germination started from the 2nd day and made a steady progress in rapid rate up to 10th day. On the 10th day, 62% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1791.8 per plant.

***Tridax procumbens* L.:** The average number of capitula produced by an individual of this species is 20 and 44 seeds in one fruit. This brought the average seed-output of the species to 880. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 36% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 316.8 per plant.

***Triumfetta rhomboidea* Jacq.:** The average number of fruits produced by an individual of this species is 127 and 1 seed in one fruit. This brought the average seed-output of the species to 127. In the absence of light, germination started from the 1st day and made a

steady progress in rapid rate up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 10.16 per plant.

***Urena lobata* L.:** The average number of fruits produced by an individual of this species is 38 and 5 seeds in one fruit. This brought the average seed-output of the species to 190. In the absence of light, germination started from the 2nd day and made a steady progress in rapid rate up to 10th day. On the 10th day, 20% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 38 per plant.

***Youngia japonica* (L.) DC.:** The average number of capitula produced by an individual of this species is 156 and 23 cypsela in one capitulum. This brought the average seed-output of the species to 3588. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 287.04 per plant.

II. MONOCOTS:

***Chrysopogon aciculatus* (Retzius) Trinius:** The average number of fruits produced by an individual of this species is 76, and 1 seed in one fruit. This brought the average seed-output of the species to 76. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 80% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 60.8 per plant.

***Cyperus compressus* L.:** The average number of fruits produced by an individual of this species is 10388, and 1 seed in one fruit. This brought the average seed-output of the species to10388. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.


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PLATE XII: Seeds or propagules of some Tea Garden weeds:

1. *Borreria alata*
2. *Mitracarpus verticillatus*
3. *Oxalis corniculata*
4. *Hyptis suaveolens*
5. *Synedrella nodiflora*
6. *Chromolaena odoratum*
7. *Sida acuta*
8. *Bidens pilosa*
9. *Cassia occidentalis*
10. *Cleome rutidosperma*
11. *Vernonia cinerea*
12. *Ageratum conyzoides*


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PLATE XIII: Seeds or propagules of some Tea Garden weeds:

13. *Leucas indica*
14. *Eclipta prostrate*
15. *Croton bonplandianum*
16. *Ageratum houstonianum*
17. *Cynoglossum lanceolatum*
18. *Elephantopus scaber*
19. *Heliotropium indicum*
20. *Blumea lacera*
21. *Phaulopsis imbricata*
22. *Solanum myriacanthum*
23. *Tridax procumbens*
24. *Polygonum plebeium*

***Cyperus cyperoides* (Retzius) O.Kuntze:** The average number of fruits produced by an individual of this species is 13566, and 1 seed in one fruit. This brought the average seed-output of the species to13566. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Cyperus tenuispica* Steudel:** The average number of fruits produced by an individual of this species is 149, and 1 seed in one fruit. This brought the average seed-output of the species to 149. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Fimbristylis dichotoma* (L.) Vahl:** The average number of fruits produced by an individual of this species is 232, and 1 seed in one fruit. This brought the average seed-output of the species to 232. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Kyllinga nemoralis* (J. R. & G. Forster) Dandy ex Hutchinson & Dalziel:** The average number of fruits produced by an individual of this species is 4864, and 1 seed in one fruit. This brought the average seed-output of the species to 4864. In the absence of light, germination started from the 10th day and made a steady progress up to 10th day. On the 10th day, 5% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 243.2 per plant.

***Paspalum scrobiculatum* L.:** The average number of fruits produced by an individual of this species is 710, and 1 seed in one fruit. This brought the average seed-output of the species to 710. In the absence of light, germination started from the 8th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 7.1 per plant.

***Setaria pumila* (Poiret) Roemer & Schultes:** The average number of fruits produced by an individual of this species is 141 and 1 seed in one fruit. This brought the average seed-output of the species to 141. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 48% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 67.68 per plant.

9.4.2 Estimation of Seeds per Fruit

After determining the average number of seeds a fruit produces by the 71 species of dicotyledonous plants, it is found that the highest number of 1520 seeds is produced by *Ludwigia perennis* (Onagraceae). It is then followed by *Melastoma malabathricum* (997), *Osbeckia nepalensis* (580) *Solanum aculeatissimum* (337), *Solanum torvum* (225), *Scoparia dulcis* (223), *Hypericum japonicum* (221), *Mazus pumilus* (217), *Lindernia crustacea* (130), *Glinus oppositifolius* (77) etc. Among the first ten dicotyledonous weedy species with higher number of seeds per fruit, highest seed producer belongs to Onagraceae, two from Melastomataceae and Solanaceae; three belongs to Scrophulariaceae and one each of Hypericaceae and Molluginaceae. There have been 46 (64.79%) species of weeds, which bear more than 1 seeds per fruit, and only 25 (35.21%) species produce 1-seeded fruits. This last category of plants is belonging to the families Amaranthaceae, Asteraceae, Piperaceae, Polygonaceae, Tiliaceae and Urticaceae.

On the other hand, all the monocotyledonous weeds under study produce only 1 seed per fruit. These plants are belonging to Poaceae and Cyperaceae only.

9.4.3 Seeds per Plant

In case of dicotyledonous weeds, highest number of seeds per plant has been recorded in *Conyza canadensis* (885360) of Asteraceae. It is followed by *Ludwigia perennis* (437760), *Scoparia dulcis* (146734), *Osbeckia nepalensis* (141520), *Melastoma malabathricum* (101694), *Blumea lacera* (87142), *Ageratum houstonianum* (33820), *Plantago erosa* (25687), *Acmella paniculata* (20584), *Glinus lotoides* (18038) etc.

Among the first ten dicotyledonous weed species of higher number of seeds per plant, four belongs to Asteraceae, two of Melastomataceae, one each of Onagraceae, Scrophulariaceae, Plantaginaceae and Molluginaceae. Lowest number of seed produced per plant has been observed in *Centella asiatica* (78) under Apiaceae and other plant which contain less than 300 seeds per plant include *Triumfetta rhomboidea* (127), *Melochia corchorifolia* (170), *Urena lobata* (190), *Clerodendrum viscosum* (252) etc.

In monocotyledonous weeds highest number of seeds per plant has observed in *Cyperus cyperoides* (13566) followed by *Cyperus compressus* (10388), *Kyllinga nemoralis* (4864), *Eragrostis tenella* (2044), *Paspalum scrobiculatum* (710) etc. Among these five high seed producer monocotyledonous weeds three belongs to Cyperaceae and two belongs to Poaceae. Lowest seed production has been observed in *Chrysopogon aciculatus* (76) of Poaceae. Other plants those produce less than 300 seeds per plant, include *Fimbristylis dichotoma* (232), Cyperus *tenuispica* (149), *Setaria pumila* (141) and *Chrysopogon aciculatus* (76) etc.

9.4.4 Seed Weight

Seeds of dicotyledonous weeds show higher seed-weight than the monocotyledonous ones. Here the seed-weight has been presented as 1000 seed's weight in gram. Top-ten high seed-weight plants are *Clerodendrum viscosum* (47.199 g), *Cassia tora* (20.457gm), *Cassia occidentalis* (15.809 g), *Urena lobata* (12.94 g), *Ipomoea quamoclit* (12.4 g), *Crotalaria pallida* (10.762 g), *Tephrosia candida* (9.42 g), *Croton bonplandianus* (7.083 g), *Triumfetta rhomboidea* (5.07 g) and *Melochia corchorifolia* (4.443 g). Among these the topper belongs to Verbenaceae, 2 are of Caesalpinaceae and Fabaceae s.s. and 1 each of Malvaceae, Convolvulaceae, Euphorbiaceae, Tiliaceae and Sterculiaceae.

Among Dicotyledons, *Melastoma malabathricum* bears lightest seed-weight of 0.004 g only for 1000 seeds. Other dicotyledonous weeds, which have seed weight less than 0.100 g are *Ageratum conyzoides* (0.099 g), *Borreria ocymoides* (0.086 g), *Youngia japonica* (0.083 g), *Mazus pumilus* (0.08 g), *Euphorbia hirta* (0.057 g), *Conyza*

canadensis (0.04 g), *Blumea lacera* (0.039 g), *Polycarpon prostratum* (0.032 g), *Osbeckia nepalensis* (0.025 g), *Glinus oppositifolius* (0.022 g), *Ludwigia perennis* (0.02 g), *Oldenlandia diffusa* (0.02 g), *Oldenlandia corymbosa* (0.013 g), *Scoparia dulcis* (0.01 g), *Gamochaeta pensylvanicum* (0.007 g), *Glinus lotoides* (0.007 g), *Hypericum japonicum* (0.006 g), *Melastoma malabathricum* (0.004 g) etc.

All the monocotyledonous weeds bear seed-weight less than 1.000 g for 1000 seeds. Among them highest seed weight has been observed in *Paspalum scrobiculatum* (0.778 g) and that is followed by *Chrysopogon aciculatus* (0.572gm), *Setaria pumila* (0.148gm), *Kyllinga nemoralis* (0.147gm), *Cyperus compressus* (0.126 g) etc. Among these top five species with high seed weight, three belongs to Poaceae. 4 and 2 species are of Cyperaceae. Lowest seed weight among monocotyledonous weeds has been observed in *Eragrostis tenella* (0.02 g) of Poaceae.

9.4.5 Germination Percentage

Out of the 71 species of dicotyledonous weeds ubder study, highest germination percentage has been observed in *Hyptis suaveolens* (98%) of Lamiaceae and that is followed by *Pupalia lappacea* (97%), *Cassia tora* (93%), *Melochia corchorifolia* (80%), *Osbeckia nepalensis* (72%), *Cassia occidentalis* (70%), *Phaulopsis imbricata* (64%), *Tephrosia candida* (62%), *Cyanthillium cinereum* (59%), *Emilia sonchifolia* (59%), *Synedrella nodiflora* (50%) etc.

Lowest germination percentage of 1% among the dicotyledonous weeds under study has been observed in five species like *Amaranthus viridis, Cleome rutidosperma, Euphorbia hirta, Persicaria orientalis,* and *Plantago erosa.* Species like *Mitracarpus verticillatus*, *Oldenlandia corymbosa* and *Oldenlandia diffusa* showed only 3% germination, *Solanum nigrum* showed only 4% germination, *Amaranthus spinosus* showed only 6% germination, *Acmella paniculata, Ageratum conyzoides* and *Pseudognaphalium affine* showed only 7% germination, *Conyza canadensis*, *Gamochaeta pensylvanicum*, *Scoparia dulcis*, *Sida acuta*, *Stellaria media*, *Triumfetta rhomboidea*, and *Youngia japonica* showed only 8% germination. Whereas 26 species of

dicotyledonous weeds showed complete dormancy within the time frame of this *in vitro* experimental set-up.

In case of monocotyledonous weeds highest percentage of germination has been observed in *Chrysopogon aciculatus* (80%) and *Setaria pumila* (48%). Both the species belongs to Poaceae. Lowest percentage of germination observed in *Paspalum scrobiculatum* (only 1%) of Poaceae and *Kyllinga nemoralis* (only 5%) of Cyperaceae. Whereas all other species like *Cyperus compressus, Cyperus cyperoides, Cyperus tenuispica, Eragrostis tenella* and *Fimbristylis dichotoma* showed complete dormancy within the time frame of this *in vitro* experimental set-up.

9.4.6 Reproductive Capacity (RC)

In case of dicotyledonous weeds, highest reproductive capacity has been observed in *Osbeckia nepalensis* (101894.4) belonging to Melastomataceae, which is followed by *Conyza canadensis* (70828.8), *Melastoma malabathricum* (14237.16), *Pupalia lappacea* (12796.24), *Scoparia dulcis* (11738.72), *Cassia tora* (9951), *Ageratum houstonianum* (8116.8), *Cyanthillium cinereum* (4672.8), *Emilia sonchifolia* (4363.64) and *Crotalaria pallida* (3919.8) etc. Of the high reproductive capacity holding species, four belongs to Asteraceae, two of Melastomataceae and one each of Amaranthaceae, Scrophulariaceae, Caesalpinaceae and Fabaceae (s.s.).

On the other hand, lowest Reproductive Capacity has been observed in *Euphorbia hirta* only 8.49 of Euphorbiaceae and that is followed by *Triumfetta rhomboidea* 10.16, *Amaranthus viridis* 18.41, *Cleome rutidosperma* 21.93, *Sida acuta* 36.16, *Urena lobata* 38, *Elephantopus scaber* 40.8, *Persicaria orientalis* 45.57 etc. Whereas 26 species of dicotyledonous weeds has not been shown the reproductive capacity value due to their complete dormancy during the *in vitro* experiment.

In the case of Monocotyledonous weeds the highest value of Reproductive Capacity has been shown by *Kyllinga nemoralis* (243.2) of Cyperaceae, which is followed by *Setaria pumila* 67.68 and *Chrysopogon aciculatus* 60.8 (both of Poaceae).

On the other hand, the lowest RC value has been shown by *Paspalum scrobiculatum* (7.1), which is also belonging to Poaceae. The RC of all other plants under Cyperaceae like *Cyperus compressus, Cyperus cyperoides, Cyperus tenuispica* and *Fimbristylis dichotoma* and *Eragrostis tenella* of Poaceae was not determined as their seeds were not germinated in the *in vitro* experimental conditions.

9.4.7 Reproductive Potential (RP) of Successful Families

From the stand point of Reproductive Potentiality, the presently discussed weed flora Terai Tea Gardens showed Poaceae as the most successful family. Asteraceae occupied the second position and Cyperaceae and Fabaceae (s.s.) jointly occupy the 3rd position. Rubiaceae and Scrophulariaceae jointly occupy the 4th position and Amaranthaceae and Euphorbiaceae occupy 5th position jointly.

In Poaceae the range of seed production per plant varies from 76 to 2044 and their 1000 seed-weight ranged between 0.02 – 0.778 g. In Asteraceae, seed per plant ranges from 340 to 885360 and 1000 seed-weight ranges between 0.007 – 2.8g. The values of seed output and 1000 seed-weight of these important families has been presented in Table 9.3.

Table 9.3: Five high RP Angiospermic families with their seed output and 1000 seeds weight.

Families	Seed output	1000 seeds-weight in g	RP value
Poaceae	76 – 2044	0.02 – 0.778	7.1 – 67.68
Asteraceae	340 – 885360	0.007 – 2.8g	40.8 – 70828.8
Cyperaceae	149 – 13566	0.048 – 0.147	243.2
Fabaceae s.s.	2890 – 13066	9.42 - 10.762	1791.8 – 3919.8
Rubiaceae	678 – 7906	0.013 - 2.949	146.34 – 237.18
Scrophulariaceae	7930 – 146734	0.01 - 0.25	11738.72
Amaranthaceae	1841 – 13192	0.215 - 2.349	18.41 – 12796.24
Euphorbiaceae	531 – 10320	0.057 - 7.083	8.49

So among the recorded weeds of five most successful families, only 26.67% (i.e.12 species) bear less than 1000 seeds per plant and 73.33% (i.e. 33 species) bear more than 1000 seeds per plant. On the other hand only 20% (i.e. 9 species) shows seed

weight more than 1.0g per 1000 seeds and 80% (i.e. 36 species) shows seed weight less than 1.0g per 1000 seeds.

There is positive correlation between seed weight and seed number generally exists within different members in a particular family. This finding is getting its support from Dutta & Banerjee (1976). Holzner & Numata (1982) commented that one must be aware that due to the high plasticity of weeds, seed number may vary from none to some hundreds of thousands or even millions per plant within one species. In the context of seed weight, there also exist some variations. Stevens (1932) pointed out that the differences are due to the selection and cleaning of seeds. However, the paucity of data on seed number and seed weight may be due to the following facts (a) selection of the plant (b) competition during growth (c) nature of collection (i.e. either from the crop field or outside) (d) cleaning of seeds (e) proper drying etc.

The successful families of the present flora viz. Poaceae and Cyperaceae also support Salisbury's (1956) view who states that some of the most successful species are those which exhibit a large seed out put and possesses also a means of vegetative propagation. This later method provide the equivalent of a large food supply in the seed but over a much longer period and thus permits tolerance of greater and more prolonged competition by the vegetatively produced off-springs. The ability to propagate both by seeds as well as vegetatively is an advantage to the plant and that must be one of the reasons behind the success of the species as a weed. Grasses and sedges have the capacity to produce large number of seeds as well as they propagate vegetatively and that is why they generally dominate the weed floras.

Though majority of the species of Asteraceae does not reproduce vegetatively but they have some other specials features to become successful weeds, which include (a) majority are anemochore species i.e. send their seeds away from the mother plant by air (b) seeds are furnished with special devices such as pappus which increase the ability to disperse by air to a new habitat (c) rosette growth to occupy a certain amount of space (e.g. *Blumea lacera*) (d) some exotic species dispersed by man with his traffic and transport systems to a new habitat etc.

Other families including Fabaceae s.s., Rubiaceae, Scrophulariaceae, Amaranthaceae and Euphorbiaceae also produce large number of small seeds and consist mainly of clitochore species i.e. the species shed their seeds around the mother plant and relay on dispersal in time rather than in space. They do not have any sophisticated dispersed devices because man himself is by far the most important agent for dispersal of crop field weed seeds with his livestock, transport devices, agriculture machinery, irrigation systems and so on or sometimes they are able to disperse their seeds by any special means to a few meters. So, the seedlings are threatened by intraspecific competition.

But the weeds overcome this situation with their (a) prolong germination time and (b) only a small portion of seed germinate at a time and even this portion does not germinate at the very same time. These weeds also have the ability to continuous seed production for as long as the growing condition permit and wide amplitude of modification plasticity and adaptability (Ehrendorfer, 1965) enabling the population to survive and produce seeds in a wide range of ecological conditions. On the other hand the weed species which bear small number of large seeds also get good opportunity of establishment because large seeds carry much food for the seedling and make it as independent as possible from the supply of nutrients and light from the environment and also enhance the seedling growth during the time of establishment.

In Poaceae, except *Eragrostis tenella,* which shows complete dormancy in an *in vitro* experiment with a pre-determined duration, whereas others exhibit 1 – 80 % germination and reproductive potentiality ranges from 7.1 to 67.68. In Asteraceae, except *Blumea lacera,* which shows complete dormancy in an *in vitro* experiment with a pre-determined duration, germination % ranges between 7 to 59 % whereas RP ranges from 40.8 to 70828.8. In Cyperaceae, except *Kyllinga nemoralis,* all other species those show complete dormancy in an *in vitro* experiment with a pre-determined duration, which exhibit only 5% germination and only 243.2 RP. In Fabaceae s.s., germination % ranges between 30 – 62 % and RP shows 1791.8 - 3919.8. In Rubiaceae, two species viz.

Borreria ocymoides and *Richardia scabra* did not germinate and remained dormant in an *in vitro* experiment with a pre-determined duration. But in other cases germination percentage ranges between 3 – 29% whereas RP ranges from 146.34 to 237.18. In Scrophulariaceae, only *Scoparia dulcis* shows 8 % germination and 11738.72 RP whereas all other species did not exhibit RP due to their complete dormancy. In Amaranthaceae, all species germinated and shows germination percentage from 1% upto 97% and RP exhibit from 18.41 to 12796.24. In Euphorbiaceae, except *Euphorbia hirta,* all other species are dormant in an *in vitro* experiment with a pre-determined duration and *Euphorbia hirta* shows very less germination (i.e. only 1%) and off course very less RP, which is only 8.49.

So among the recorded weeds of five most successful families, 31.11% (i.e.14 species) are fully dormant with in vitro germination experiment with pre-determined duration under laboratory conditions and 55.55 % (i.e. 25 species) shows less than 50 % germination and 33.33 % (i.e.15 species) exhibit less than 500 value for RP.