Data Essential to Completeness of Reports on Seed Germination of Native Plants
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NOTES AND COMMENT

THE INDIAN ECOLOGIST—A NEW JOURNAL

Ecology has just received Volume I, Number 1 of a new journal entitled "The Indian Ecologist" and wishes to call this enterprise to the attention of American ecologists. The Indian Ecologist is edited for the Indian Ecological Society by *F. R. Bharucha* of the Royal Institute of Science, Bombay. In the prefatory note Professor Bharucha points out that the journal will serve ". . . as an agent for the co-ordination of ecological research and a vehicle for the dissemination of ecological knowledge to enable the Indian Ecological Society to play its rightful part in this critical period of reconstruction."

The Indian Ecological Society was established five years ago to promote biological research in pedology, meteorology, and cognate fields as well as along more characteristic ecological lines. During the war certain important projects were conducted with its assistance. The Society, and its journal, now envisages an active career of research and publication in all of ecological science.

Because of paper shortage the journal will appear twice a year for the time being and will publish only reports of original investigations. Later, as this shortage eases, a quarterly is planned that will also contain book reviews, notes on topics of ecologic interest, and reports of activities at various ecological centers.

It is interesting to record that the National Institute of Sciences of India furthered this project by obtaining a donation in its behalf from The Rockefeller Foundation.

The first issue, consisting of 66 pages and 24 figures, contains the following seven articles:

(1) The micro-climates of plant communities. L. A. Ramdas.
(2) Contour strip-cropping: an ecological aspect of soil conservation. J. K. Basu and L. Sreenivas.
(3) A study in the ecology of low lying lands ....R. Misra.
(4) On the aerenchyma of *Sesbania aculeata* Poir ....J. F. R. d'Alemeida.
(5) A preliminary study in drought resistance of sugar cane ....A. K. Mallik.
(6) Ecology and evolutionary trends in adult Trichoptera ....P. J. Deoras.
(7) Artificial key to the Compositae of Bombay Presidency ....H. Santapau.

In closing his introductory remark Professor Bharucha says, "And so we go to press in a spirit of endeavour and service, and with every confidence and hope of an active, useful and long career."

We add our personal welcome to this new venture and wish it every success!

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DATA ESSENTIAL TO COMPLETENESS OF REPORTS ON SEED GERMINATION OF NATIVE PLANTS[1]

Scientists will agree that an important criterion of a well-written report on an experiment is whether the details recorded are adequate to enable another worker to duplicate the procedure and to attain approximately the same results with the same experimental material.

A critical survey of sixty-four publications since 1930 dealing with storage and germination of 364 species of seeds reveals that the data supplied in most cases are so fragmentary that duplication of the test by another worker would be entirely impossible. A large proportion of the inconsistency in the literature may be ascribed to the fact that conflicting results of various workers cannot be properly evaluated. One cannot tell whether the differences are inherent in the test conditions or in the genetic makeup of the organisms.

It would seem that many seed experimenters have not recognized a number of the factors which may affect the results of germination tests. It is suggested, therefore, that the inclusion of all pertinent[2] items listed in the following outline would result in completeness and uniformity of future reports on seed germina-

[1] It is a pleasure to acknowledge the helpful criticism of the following persons: Mr. Eugene I. Roe, Lake States Forest Experiment Station; Dr. Henry I. Baldwin, State of New Hampshire Forestry and Recreation Commission; Dr. Lela V. Barton, Boyce Thompson Institute for Plant Research; and Professors Ernst C. Abbe, Carl W. Sharsmith, and William S. Cooper, all of the Department of Botany, University of Minnesota.

[2] Some items listed here may not be pertinent in a particular case; the test of pertinence is trial and observation.

tion, and would restrict the accumulation of irreconcilable reports.

1. Kind of plant: Genus, species, and any finer distinction possible.
2. Exact geographic locality and date of seed collection.
3. Age and size of parent plant; location on the plant, size, and color of the parent fruit; and whether seed was collected from the plant or from the ground.
4. Extraction of seed from fruit: Hand extraction from pods, kiln-drying of cones (with a record of duration, temperature, and humidity), maceration of fleshy fruits in hammer mills, hand rubbing in screens, de-winging or awn-removal by hand or by machine, or cleaning by air blast (pressure recorded).
5. Nature of seed: Maturity, including date when seed became mature; size; color; moisture content when collected, expressed as a percentage of dry weight; percentage of seeds ascertained to be sound by cutting test; number per pound of clean, pure, apparently sound seed; and unusual weather conditions that occurred during development of the seed.
6. Place of testing and date test was begun.
7. Pre-storage treatment: Surface sterilization, chemical or mechanical treatment, passage through a digestive tract, drying, etc.
8. Storage conditions and pre-germination treatment (including stratification) up to the time when conditions favorable to germination[3] were supplied: (*a*) The kind and amount of storage medium (vacuum, air (including humidity), peat, sand, soil, water, etc.), kind and size of container, and volume and weight of seed mass as compared with volume of container space; (*b*) moisture conditions including kind and amount of water used (distilled, chlorinated, hard, etc.); (*c*) acidity (stating method of measuring), soluble substances, and aeration; (*d*) micro-organisms; (*e*) light (intensity and daylength); (*f*) temperature (constant or alternating); (*g*) weight and moisture content of the seed at beginning and at end of storage; (*h*) length of storage period and duration of pre-germination treatment, and dates of beginning and end; and (*i*) items listed in section 7 if given following storage or if no storage occurred.
9. Germination conditions: Mainly the same headings listed in section 8 and including weight and moisture content of seed at beginning of germination period, soil and air temperatures, and depth of sowing.
10. Length of germination period,[3] including dates of initiation of favorable germination conditions, and first, peak, and last germination.
11. Germination habit: Epigeous or hypogeous.
12. Percentage germination resulting from all treatments and conditions tested: Including (*a*) potential germination percentage (number of filled sound seeds that appeared capable of germinating at beginning of test, expressed as a percentage of the total sample, including empty seed), (*b*) apparent germination percentage (number of seedlings expanded by end of test expressed as a percentage of the total sample, including empty seed), and (*c*) real germination percentage (number of seedlings expanded by end of test expressed as a percentage of the number of filled sound seeds that appeared capable of germinating at start of test—not as a percentage of total number of seeds used).
13. Number of seeds tested and number of replications of the test.
14. Minimum time necessary from collection of seed to peak germination in laboratory and greenhouse tests, and out-of-doors.
15. Recommended procedures for attaining best[4] germination.

In many germination experiments some of the foregoing information is lacking, often necessarily so. In reporting such cases it would seem desirable to indicate clearly just what data have not been, or could not be, obtained. These statements would be of use in evaluating the experiments.

It is regarded as highly important that workers in this field should preserve as herbarium specimens, properly labeled and numbered according to standard taxonomic procedure, the developmental stages of representative seedlings from each test, and flowering and fruiting stages from the parent plant. These should be de-

[3] In accordance with the definition of Baldwin, germination is considered to be "the development of the plantlet from the seed." For the sake of accuracy, the dates of root and shoot expansion should be noted separately if they do not occur simultaneously, and a seed should not be assumed to have germinated until both have expanded.

[4] *Best* here means a combination of simplicity, speed of method, and uniformly timed high germination percentage, that would make the procedure most useful to an experimenter needing a large number of uniform seedlings at one time.

posited in some well-known herbarium for later critical study, and in each publication dealing with this material, reference should be made to the collector's number and the place where the herbarium material is filed. These precautions are necessary because of the vagaries of taxonomic nomenclature and the confusion that results when concrete evidence regarding identity is not preserved.

Workers planning germination tests should refer to "Rules and recommendations for testing seeds" (United States Department of Agriculture, '38), and should consider the following quotation from Baldwin ('42, pp. 104–105). "Knowledge of the proper pretreatment to induce prompt and complete germination can best be gained by a study of the ecological factors affecting the seed in its natural habitat between the time of maturity and germination. With rare exceptions this has not been done."

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ON THE PONDERAL INDEX, OR CONDITION FACTOR, AS EMPLOYED IN FISHERIES BIOLOGY

A note by Chase ('46) giving account of the calculation of fish condition factors from scale dimensions in the Bluegill *Lepomis machrochirus,* refers (both directly and by default) to certain points of interest in this section of fisheries biology. It is desired to make some comment on the particular points and on the general question.

Chase's procedure, designed to permit calculation of the condition of fish at points in time preceding that at which the fish were captured, consists apparently of two calculations and involves an intermediate argument. Firstly, intermediate lengths are calculated from scale dimensions (antero-posterior length) according to classical procedure; he finds the relation of scale dimension to fish length to be linear except for the first annulus. Secondly, it is stated that there is a cubic relation between weight and the width of the scale. Thirdly, a formula constructed from the first two permits the calculation of the condition of the fish. Measurements required are: total length at capture, scale width and length at each "break" or annular margin. An account is given of certain corrections and technical precautions.

The first point of interest is the relation stated to exist between scale width and weight. This is intermediated by (1) a close relation between variations in depth and variations in weight and (2) a linear relation between depth and scale width. It would be expected that for a particular length a deeper fish would be a heavier one, but it is to be observed that the converse is also true, that is, for a given depth, a longer fish would also be heavier. Chase's argument would appear to be: the heavier the fish, the greater its depth and the wider the scale (or conversely); this, if true, would be a valuable piece of evidence, but actually Chase himself questions it ("To what extent is a change in depth associated with a change in scale width or with a change in degree of overlap?"); apparently this relation is not yet established and in fact the relation of weight with scale length might be better, for these purposes, than that with scale width.

A further consequence of this argument is that it implies heterauxetic relations between the growth axes of the scale, and although such a condition has already been described (Van Oosten, '28) it is difficult to imagine such a differential being quadratic, yet this must be the case if the one axis has a linear relation with the length of the fish and the other is related to the cube of the length.

A final and perhaps more important difficulty is that condition factor studies are primarily intended for examination of inter-seasonal variation, which, in any case, considerably influences any examination of annual variation. The present author is not aware of any work suggesting that scales are sensitively responsive, in the degree which would be necessary for these studies, to the variation in condition of fish; the usual idea of the relation between scale and total length is that after some initial complexity this straightens out and if, because of food deficiency, growth must temporarily cease, this applies both to scale and to total length; it is also held in some quarters that major incidents, such as migrations, cause erosion of the scale, but whether this erosion would be held to have quantitative relation with any loss in