Independent research projects and technical writing for freshmen

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ABSTRACT

Coordination of instruction in technical writing and the conduct of an independent research project in an introductory plant science course serves to introduce freshmen to technical writing and research methods concurrently. A style manual tailored to the resources available at the Nova Scotia Agricultural College is a key ingredient to success with instruction in scientific writing at this institution.

Additional index words: Style manual, Term reports.

INDEPENDENT research projects have been a part of the introductory plant science course at the Nova Scotia Agricultural College (NSAC) since 1971. They are modeled after the projects in the introductory course at the University of Missouri discussed at the 1971 American Society of Agronomy meetings in New York and later described by Nelson et al. (1973). Nelson's objectives were:

1. To encourage independent research, critical thought, and logical analysis.
2. To help students understand the scientific method and realize why each step is necessary.
3. To develop in the student a working knowledge and appreciation of the library as a research resource.
4. To introduce the student to additional scientific information in the plant science area.
5. To acquaint the student with other members of the College of Agriculture faculty.

We adopted the first four objectives and added an objective to better develop technical writing skills. These adopted and added objectives represent what we want the students to learn.

From 1971 to 1973, our introductory course was available to sophomore students, and classes consisted of 30 to 40 students each. Students were able to conduct a replicated greenhouse or growth chamber experiment, which was the basis for a scientific report. Difficulties with instruction in the writing of these and other scientific reports led to the formation of a faculty committee and preparation of a style manual for the writing of scientific and technical reports at NSAC.

Faculty agreed that NSAC's requirements would be as specific as they are for any particular journal and that we would follow as closely as possible the editorial style of the Canadian journals published by the Agricultural Institute of Canada.

The Nova Scotia Agricultural College Style Manual (1986) is revised annually and is in its 10th revised edition. It contains information on setting up title pages and tables of contents, writing abstracts, introductions, literature reviews, results, and conclusions with some examples of current conventions in different disciplines. It is designed to accommodate differences in style for those writing in agronomy vs. other disciplines (for example, entomology), while at the same time offering students and instructors an agreed-upon pattern for scientific writing. The manual is specific to the library resources available at NSAC and includes examples of published scientific papers, most of which were written by the NSAC faculty.

The college curriculum underwent a major revision in 1972, which led to the introductory plant science course and the English course (which includes technical writing) being offered simultaneously in the first semester of the degree program. This means that freshmen students undertake an independent research project and write a scientific report during their first semester in our degree programs. Students do not select options until they enter the third semester. We recognized in 1972 that these students are not prepared to plan an experiment, but we still wanted each student to do a plant growing project, search the literature, and prepare a properly organized term report. We also decided to have each student do something different, which ensured each did an independent library search.

We set up some standard comparisons such as response to growing temperatures, day length, flooding, soil pH, and chilling injury and made available a series of crops so that several students could do a growing temperature comparison and each use a different crop. Students who wanted to design their own experiment could do so; some have tried to grow plants in soils from home, or compare fertilizer sources. It has been a challenge to get all students to grow something within 2 weeks of their arrival on campus, especially as numbers in the course have increased from the 30 to 40 students (1971–1973) to 139 (1985). This increase in students entering the B.S. (Agric.) program at NSAC took place after facilities and staff were expanded to permit completion of the degree on our campus. Previously students had to complete the final 2 yr of the degree at another Faculty of Agriculture, usually MacDonald College of McGill University or the University of Guelph.

Coordination of technical writing instruction, which includes an introduction to library resources, with the independent research project in our introductory plant science course has been mutually beneficial to instruction in both courses. This involves giving the plant science student a deadline to complete the literature review portion of the written project by about 1 November, which is near the midpoint of our first semester.
During the first half of the semester they receive instruction on technical writing in their first-year English course, learn to use the library, and immediately apply their learning to the writing of a scientific review.

The instructor in the English course uses only the NSAC Style Manual as a technical writing text; however, several other references on technical writing are listed in the style manual and are available to the students.

This English course, which is designed specifically for degree and technical students in agriculture, permits only about one-half the attention to literature that is included in most first-semester English courses. Some compensation is made by increasing the literature component in a second required English course scheduled for most students in the fourth semester. This adjustment of course content is facilitated by having only the Faculty of Agriculture on our campus, so our Humanities Department is primarily concerned with servicing the needs of agriculture students. Although the NSAC Humanities Department offers courses in literature, history, sociology, and rural extension, the department's primary intention for first-year students is to develop ability in scientific and technical writing.

Our students, like most other freshmen, do not really start on their literature reviews until just before the 1 November deadline. We try to set our deadline shortly after midterm tests are written in most courses and prepare for an onslaught of students seeking help. Instructors make themselves available in the library as much as possible just before the deadline and help students search the indices to the abstracting journals to start to locate appropriate references. We then try to mark and return all literature reviews within 3 weeks. Some are returned as unacceptable, and a rewrite is required. Acceptable literature reviews are returned to the students for incorporation, unchanged, into the complete term report. This process is handled by a plant science instructor and, when available, a graduate student teaching assistant. It requires a lot of time and effort that is hard to justify if only the introductory plant science course is considered. We justify our effort by considering the overall development of the student together with the savings in effort required with more advanced students who are required to complete projects and term reports in subsequent plant science courses.

While they carry out literature searches, students also observe and collect measurements on their growing plants. They are challenged with the problems of what and how to measure, as well as how to organize data. Although very time-consuming, this leads to a lot of one-on-one contact between staff and students and stimulates interest in plant experimentation. All members of the Plant Science Department are likely to become involved with one or more students who are seeking help in this course. These contacts often lead to lasting bonds between students and staff, help staff select summer student assistants, and help students decide whether or not to elect a major in the plant science option.

We realize that the procedure followed and outlined above is not orthodox in method. We emphasize to the students that the proper procedure for carrying out a research project is first to complete a literature review; then to set objectives and design an experiment that can be properly analyzed statistically, to specify what is to be measured and how this is to be done; then to systematically carry out the experimental work and prepare a scientific report. Students seem to appreciate that we cannot follow this proper method in our introductory course project, and those who choose the plant science option do follow orthodox procedures when they carry out their required final year research projects. We also believe that the students' attempts to draw conclusions from these introductory projects make them appreciate the needs for courses in statistics before they can properly design experiments and interpret data. Our initial concern that we might confuse our beginning students as to proper scientific methods appears unfounded.

As far as student grades are concerned, about one-half of the first English course marks are assigned to technical writing. Students also prepare reports in the concurrent plant science course or a concurrent physics course taken by pre-vet students in which satisfactory technical writing is demanded. In courses where term reports are required, they often account for 10% or more of the grade. Although most of the grade on projects is generally based on content, any student who submits a report that does not conform to requirements specified in the NSAC Style Manual may, at the discretion of the instructor, have the project rejected outright or returned for correction. If it does not meet standards acceptable to the instructor, a student may get zero for the report. This continued reinforcement of requirements for satisfactory technical writing is a key factor for maintaining high standards of technical writing.

We conclude that the right time to confront students with the requirements for proper writing scientific and technical reports is at the onset of the university degree program. We recognize that secondary schools do not properly prepare most students to write. Consequently, our failure rates can be quite high in the first-year plant science course. However, those students who cannot write suitable reports also tend to fail other science courses. The independent research projects stimulate student interest in the independent investigation of how plants respond to treatments. The pleasure gained from doing their own projects seems to help compensate for the demands we make on them for reporting results. Nothing, it appears, is gained by delaying the requirement for proper scientific writing.

REFERENCES


Splashboards: A simple field and classroom demonstration of splash erosion

P. A. McDaniel and R. C. Graham

ABSTRACT

A simple method for demonstrating the effects of raindrop impact and splash erosion was developed for use in an introductory soil science course. Splashboards placed in adjacent fields captured soil splash during a rainstorm on soils with different textures and plant covers. The effects produced by a single rain event were recorded on "splashgrams" and showed varying amounts of soil splash under differing conditions. The splashgrams were used to demonstrate the splash erosion process and how it is affected by plant cover and soil texture. The method is an effective, inexpensive teaching aid that can be utilized in a variety of educational situations.

Additional index words: Conservation, Universal Soil Loss Equation (USLE), Raindrop impact.

One desirable objective of an introductory soil or crop science course is to help students understand what causes soil erosion. Examples of rill and gully erosion are often obvious and can serve as good field teaching examples. However, the effects of raindrop impact and soil splash are more subtle and perhaps not as easily demonstrated to students. A simple method to help demonstrate these forms of soil erosion was developed for use in the introductory soil science course at North Carolina State University. This demonstration uses splashboards as a means of illustrating the K (soil erodibility) and C (cover-management) factors in the Universal Soil Loss Equation (Wischmeier and Smith, 1978) and can be easily adapted for either field or laboratory use.

MATERIAL AND METHODS

The method presented in this article is a modification of the splashboards used by Ellison (1944) and Kwaad (1977) to collect samples from raindrop splash. We modified the splashboard design to obtain a permanent, removable record of raindrop splash, or a "splashgram." This is done by placing a piece of absorbent fiber paper on the splashboard to retain soil particles that are detached and splashed by raindrop impact.

Five splashboards were erected on a North Carolina State University Research Farm located near Raleigh. Each splashboard consisted of a 0.61 m by 0.81 m (2 foot by 2.66 foot) piece of 9.5-mm (0.38-inch) exterior grade plywood painted with enamel to minimize warping and deterioration. These dimensions were chosen so six splashboards could be conveniently cut from a standard 1.22 m by 2.44 m (4 foot by 8 foot) sheet of plywood. Two 0.91 m (3 foot) lengths of 12.7-mm (0.5-inch) diam steel reinforcement bar (rebar) were used as stakes to anchor each splashboard. The splashboards were attached to the vertical rebar stakes with U-bolts (Fig. 1). A 0.61 m by 0.46 m (24 inch by 18 inch) sheet of absorbent fiber paper was taped to each splashboard; heavy construction paper, commonly available in art supply stores, was found suitable for this purpose. We evaluated both black and white backgrounds for their effectiveness in recording splash erosion.

Splashboards were placed in adjacent, nearly level fields where soil texture, management practices, or vegetation differed to provide the following treatments:

- Treatment 1—clay loam texture, fallow.
- Treatment 2—clay loam texture, no-till with corn residue.
- Treatment 3—sandy loam texture, fallow.
- Treatment 4—sandy loam texture, permanent pasture.
- Treatment 5—sandy loam texture, forested with litter layer.

RESULTS AND DISCUSSION

Following a rainstorm, differences in height and amount of soil particles splashed on the various treatments were apparent (Fig. 1) and showed the ease of particle detachment and susceptibility to splash erosion. Since all splashboards were placed within 150 m of each other, the splashgrams from this single rain event could be compared. Splashgrams produced by different rain events or from sites not located near one another could differ due to variation in amount and intensity of rainfall, and comparisons would have to be made more carefully.

For display purposes, black paper best recorded the raindrop splash of light-colored and red soils since particles of these colors strongly contrast with the black background. For photographic purposes, white splashgrams showed greater contrast between soil and background when black and white film was used. Although not tested, splash erosion on dark-colored soils would undoubtedly be better recorded on white paper.

The splashgrams were coated with clear spray enamel before removal from the splashboards to help soil particles adhere to the paper. These preserved splashgrams were taken back for classroom demonstration along with a sample of the undisturbed soil surface with plant cover, if present.

We observed that splashgrams lost adhered soil particles upon drying. For best results, they should be coated and collected as soon as possible following a rainfall event.

For a classroom demonstration, splashgrams were taped up behind a plastic tray containing the appropriate soil surface (Fig. 2). This demonstration was used to graphically show students part of the basis for the K and C factors in the Universal Soil Loss Equation (USLE). Students observed the soils and splashgrams and then responded to questions relating to the effectiveness of different kinds of vegetative cover in reducing splash erosion (Table 1). Comments by students in laboratory and lecture sections of the course indicated that the splashgram display strongly increased student awareness and understanding of splash erosion.


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Table 1. Sample questions asked to students after observing the splashgram display and other laboratory activities relating to soil erosion.

1. Which types of plant cover are most effective in reducing splash erosion? Why?
2. How do soil texture and structure influence splash erosion?
3. Which kinds of agricultural crops would you expect to be associated with the greatest erosional losses?
4. In predicting erosion losses from agricultural lands, what factors must be considered?
5. How can soil erosion losses from agricultural lands be minimized?
6. What effect does urban development have on soil erosion?

**CONCLUSIONS**

The use of splashboards and splashgrams is a simple and inexpensive method to graphically illustrate the splash erosion process. The method is also an effective teaching aid in helping students understand the $K$ and $C$ components of the USLE. In addition to the crop-oriented comparisons reported here, we feel the use of splashboards can lend itself to a variety of other instructional purposes, both in the classroom and in the field. Splashboards should be effective in demonstrating splash erosion on rangelands (e.g., grazed vs. ungrazed), forest lands (e.g., skid trails, logged areas), and construction sites. Field demonstrations using this technique with simulated rainfall could also be easily performed during field trips or tours.

**REFERENCES**

A dynamic teaching tool using ants to illustrate faunal pedoturbation

by L. D. Day and M. E. Collins

ABSTRACT

A valuable teaching tool for demonstrating some aspects of faunal pedoturbation and its relation to soil horizon formation/destruction was built inexpensively and maintained in a heavily traveled hallway display case. An Ultic Haplaquod was recreated in a soil case (1 m by 0.25 m by 5 mm), and a colony of ants (Tetramorium symulium) with queen was captured and introduced at the soil surface. Over the 6 months the display was maintained, the ants clearly produced voids, chambers and tunnels, backfilled these features with soil material from different horizons, produced surface mounds, and incorporated material from below into the surface horizon. Several recommendations are given regarding the most suitable soil fauna for this form of display.

Additional index words: Soil biology, Soil genesis, Soil horizon.

One of the basic premises of soil genesis involves the balance between those processes that tend to create distinct horizons within soils and those that tend to mix up the soil into a homogeneous mass. The soil mixing process has been termed pedoturbation by Hole (1961), and many agents have been identified; when the soil animal population is involved, the process is then termed faunal pedoturbation. Effects of animals on soils can be significant and sometimes dramatic, as indicated in a well-documented review paper by Hole (1981).

When teaching students about soils and their genesis, educators commonly take a process-oriented perspective. The soil-influencing processes are usually described verbally or illustrated graphically, but seldom witnessed. Field-oriented instruction is infrequent and usually of short duration, whereas many important processes require frequent observations over extended time periods to become obvious. Relatively few agronomy and soils students become involved in the excellent field experience of soil judging. But even those who do have field experiences usually have no opportunity to witness the daily and weekly changes that occur within soil. This paper describes a method for overcoming some of these time and field restraints. The method allows observation of pedoturbation as an ongoing display.

DISPLAY DESCRIPTION

The dimensions for the soil case (Fig. 1) were chosen as 1 m by 0.25 m by 5 mm to simulate a typical soil monolith. Spacing between glass sheets, 5 mm, was chosen relative to the largest animal involved, usually the queen in an ant colony. The frame was constructed of wood and sealed with varnish before assembly. Total cost of materials was less than $20.00.

Soil (Ultic Haplaquod) was collected from a suitable site, passed through a 3-mm sieve, and the profile was recreated in the constructed soil case (Fig. 2). The soil surface was positioned about 15 cm below the top of the case.

A colony of ants (Tetramorium symulium) was located nearby the chosen soil and by careful excavation we captured the queen, approximately 100 workers, and numerous pupae and eggs all of which were deposited on top of the soil. Within minutes after closing the top seal, the colony began excavating what eventually became a complex nest of galleries, chambers, and tunnels.

The soil case was placed inside a lighted display case with pertinent descriptive material, which included the ant's position of classification among other soil-influencing animals, diagrams of the various processes influencing soil bodies, and quantitative data from literature concerning the amount of soil moved by various soil animals (Hole, 1981).

DISPLAY USAGE AND EVALUATION

Interest in the display was high from students, faculty, and staff. Over the 6 months that the display was maintained, the inhabitants actively produced many of the classical features of faunal pedoturbation including forming of voids, backfilling voids with soil material from different horizons, surface mounding, and incorporation of surface litter into the mineral surface horizon. New tunnels were constantly being created, backfilled, and redirected, and these were some of the most interesting features of the display (Fig. 3).

Although the surface mounding effect is somewhat exaggerated by compressing the exploitable soil volume into a 5-mm thickness, more than 3 cm of subsurface material was rapidly deposited over the soil surface. This demonstrates an effective anti-eluviation process and, as pointed out by Lyford (1963), Baxter and Hole (1967), and Forcella (1977), this process alone can have important impacts on the genesis and the classification of affected soils.

Interested students monitored progress daily, and the ants' ceaseless activities were of interest to people of all disciplines. Many soil/biota-related discussions were initiated while watching the ants work.

The living display had low maintenance requirements; the two primary concerns were moisture control and feeding. It was educational to discover how nesting habits and colony migrations responded to soil moisture distribution within the profile. Feeding habits of insects are very species-specific, and ants were...
Fig. 1. Soil case, showing front view (a); enlarged cross-section (b); screen-covered ventilation holes (c); removable top seal (d); back support (e); wood screws in frame (f), which secure glass panes (f).

no exception. The species chosen for this display, T. symulium, is an insect that finds sustenance from plant exudates and seed oils and unfortunately was very difficult to provide for in captivity. Species that are satisfied with easily procured food sources (e.g., honey, cheese, etc.) are advisable.

Since the entire colony can be seen in the soil case, the complete life cycle of this ubiquitous soil animal can be followed if a queen is available. The social structure of an ant colony can be very complex and this can be a fascinating study in itself.

RECOMMENDATIONS
1. Choose a soil with horizons of contrasting colors, if available, and with reasonably rapid internal drainage.
2. Choose a faunal species that is easy to feed, is fairly innocuous to humans (no fire ants!), and creates interesting nests. Nesting habits are somewhat species-specific.
3. Maintain moisture levels in the soil case between field capacity and permanent wilting point.

SUMMARY AND CONCLUSIONS
Although simple in design, this form of display is an excellent stimulus for pedological thought and discussion. While most concepts involving soil systems are communicated verbally or graphically, the faunal pedoturbaton process can be demonstrated as a dynamic display, which is of general and specific interest to nearly everyone.

Continuous observation of numerous aspects of faunal pedoturbation is allowed. Verbal and/or numerical descriptions are necessary only as supplemental information.

The display involved the field of soil (macro)biology, which typically receives very little attention in U.S. soil science curricula, despite its more serious following in European and Russian schools, and which emphasizes the interdisciplinary nature of soil science.
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