This is a field of certified Manhattan perennial ryegrass grown by Carey Strome, Junction City, Oregon. Notice the high uniformity of plant type and freedom of annual ryegrass. Good seed production starts with perennial ryegrass fields such as this. Photo is by Dr. C. Reed Funk.

FLUORESCENCE — NATURE'S HEREDITARY TRADEMARK

Ultraviolet Light Helps Decode Ryegrass Species

EDITOR'S NOTE: Five authors interested in the importance of perennial ryegrass to the turfgrass industry have written this article. They are: Richard H. Bailey, *vice-president, Turf-Seed, Inc., Hubbard, Oregon;* Dr. Henry W. Indyk, *specialist in turfgrass management, Cooperative Extension Service, Rutgers University, New Brunswick, N. J.;* Dr. C. Reed Funk, *research professor, turfgrass breeding, College of Agriculture and Environmental Science, Rutgers University, New Brunswick, N. J.;* E. E. Martin, *director of the seed laboratory, Oregon State University, Corvallis, Oregon;* C. R. Edwards, *chief of the seed branch, Consumer and Marketing Service, U.S. Department of Agriculture.*

The information presented here will familiarize the customer with ryegrass species so that he may have a better knowledge of the product he is buying.

The first section is by Richard H. Bailey.

Contamination of perennial ryegrass seed by common annual ryegrass has become an increasing problem with ryegrass breeders, producers and the customer. Although both are from the genus *Lolium, L. perene,* perennial or English ryegrass is the fineleaved shorter growing, darker green, more dense, turf-type ryegrass when compared to *L. multiflorum Lam.,* annual or Italian ryegrass which is generally, light green, fast growing, erect, hay or forage type.

The main concern of turf breeders and producers of the turf-type perennial ryegrass seed is that contamination from *L. multiflorum* does not become an uncontrollable problem. Few customers would want to seed a perennial ryegrass and later discover it contaminated with annual ryegrass.

While it has been known that perennial ryegrass has flat leaves in the bud and florets which are not awned, and annual ryegrass has rolled leaves in the bud and awned florets, the breakthrough in seedling differentiation comes in exposing seedling roots to black or ultraviolet light. *L. perenne* or perennial ryegrass does not reflect the fluorescence character. *L. multiflorum* exhibits fluorescence.

Some perennial types exhibit a degree or low percentage of fluorescence. This is the case where hybridization between *L. multiflorum* and *L. perenne* has taken place. Linn Perennial Ryegrass is such a variety. Somewhere in its genetic development there was a hybrid as one or more of the parent clones, which thus exhibited a fluorescence level which is still present in the variety.

The authors will examine fluorescence as related to: ryegrass recommendations, ryegrass breeding, ryegrass seed production and the Federal Seed Act.

Fluorescence As Related To Ryegrass Recommendations

By Dr. Henry W. Indyk

The turfgrass industry is experiencing a very exciting period in which many new turfgrass varieties are being developed by plant breeders and released to the seed trade for production and distribution. The recent development and availability of turf-type ryegrass varieties represents a major breakthrough in the improvement of ryegrasses. As a

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result, new interest has been generated in the use of ryegrass for the satisfactory establishment of various types of turfgrass areas. Because of their proven superior performance and desirable characteristics, the new turf-type ryegrasses are receiving very favorable consideration in extension service recommendations for desirable turfgrass seed mixtures in many states. This represents a major departure from the type of recognition the old type (commonly referred to as pasture-type ryegrasses) received in recommendations for desirable seed mixtures for lawns or other turfgrass areas.

Before the development of the improved turf-type ryegrasses, recommendations for high quality turfgrass seed mixtures tended to discourage the use of mixtures containing ryegrass. These pasture-type ryegrasses include the annual, perennial or a combination of annual and perennial types. Considering the characteristics of the pasture-type ryegrasses, recommendations discouraging their use were justified. Although rapid germination and establishment were definite attributes, their coarse texture, stemminess, rapid and upright growth habit (particularly in the spring), light green color and difficult mowing, imparted undesirable characteristics to an otherwise high quality lawn or turfgrass area. One might argue that these undesirable characteristics are temporary when annual ryegrass rather than the common perennial ryegrass is included in the mixture. Admittedly, the annual ryegrass tends to disappear from the mixture within the first year. However, the exit from the mixture is usually very rapid and at a very critical period during the growing season. As a consequence, the remaining stand of turfgrass is left open and vulnerable to the rapid invasion by weeds, particularly crabgrass.

Annual Ryegrass

The new turf-type ryegrasses are proving to be of great value in strengthening extension service recommendations for establishing a desirable turfgrass cover. In contrast to the pasture-type ryegrasses, they are finer textured, leafier, slower and lower growing, naturally darker green in color, more compatible in a mixture with other turfgrasses, and easier to mow. These desirable characteristics make them suitable for inclusion in turfgrass seed mixtures containing superior varieties of Kentucky bluegrass and/or fine fescue. Their attractive appearance combined with rapid establishment, durability and persistence makes them very useful for easier and more successful establishment of various types of lawn areas as well as turfgrass areas for athletics, recreation or other hard use.

A major concern in obtaining the superior performance of these improved turf-type ryegrasses is availability of high quality seed that is genetically identical to the variety developed by the breeder. Unless proper precautions are taken in maintaining high standards in the production, processing, packaging and distribution of seed, the advantages of the new variety may be easily lost due to undesirable contaminants.

Norlea perennial ryegrass can be cited as an example of what can happen. Norlea was developed and introduced as one of the first turf-type ryegrass varieties. Its advantage in comparison to the pasture-type ryegrasses was convincingly proven in variety tests. However, its popularity as an improved variety of ryegrass rapidly declined after seed was made available to the public. Its performance under practical situations was not measuring up to the results of variety tests due to the contamination of the seed with inferior ryegrasses as well as other grasses unsuitable for turf purposes.

Perennial Ryegrass

What steps can be taken to protect the genetic purity of an improved turfgrass variety and provide the purchaser with the assurance of the seed being of high quality and true to variety? Several techniques are available which in some manner may involve the breeder, seed producer, seed certification official, seed control official, seed analysts, sales outlet, and in-

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dividuals responsible for formulating and making recommendations.

One of the techniques that can be very useful is the fluorescence test. It provides seed analysts a means of detecting inferior ryegrass contaminants in certain improved turf-type varieties. Among the ryegrasses presently available, the fluorescence test can be very useful in detecting contamination in the variety Manhattan which is gaining widespread recognition for its superior performance. Seedlings of annual ryegrass as well as certain perennial ryegrasses give a positive test when subjected to the fluorescence test. Fortunately, Manhattan ryegrass seedlings are different in this respect in that they do not produce a fluorescence when subjected to the test. Therefore, by this test, a means is provided by which contamination of the Manhattan seed with interior types could be easily detected.

The inclusion of the percentage of fluorescence on the seed label that is required by state and Federal seed laws would prove to be very useful. Seed analysts would be able to readily detect contaminating ryegrasses in varieties that do not produce the fluorescence test. It would provide very useful information to individuals in the extension service responsible for making recommendations of varieties of superior performance. And perhaps most importantly, it would provide the purchaser an assurance of the genetic quality of the seed.

Flourescence And Ryegrass Breeding

By Dr. C. Reed Funk

The plant breeder is charged with the responsibility of developing the best variety attainable, using present genetic resources and plant breeding techniques. Thus, he is concerned that the merits of the variety are not lost by improper standards of seed in increase and distribution. It is therefore necessary for the plant breeder to work very closely with quality-conscious seed producers, certification specialists and seed control officials to see that quality seed of a new variety is made available to the consuming public.

The maintenance of high standards of seed production are especially important in a cross-pollinated species such as perennial ryegrass. Ryegrass seed is often produced in fields badly contaminated with annual ryegrass or stemmy, hay-type perennial ryegrass or adjacent to areas shedding pollen of these inferior types. Even a slight mixture of these coarse, tall-growing ryegrasses can cause a serious reduction in the turf performance of an improved, fine-textured, lower-growing, turf-type variety.

The improved, turf-type ryegrasses are basically poor seed producers in comparison with the annual and hay-type, perennial ryegrasses. Thus, natural selection will cause a further rapid deterioration of the turf performance potential of the improved variety as such seed fields continue to remain in production.

To insure quality seed production of improved varieties the plant breeder in cooperation with the seed producers and the certification agency places strict standards on field selection, isolation requirements, stand life and generation interval.

In the case of a synthetic variety such as Manhattan perennial ryegrass, Breeders seed is produced from vegetatively propagated parental clones grown in a clean, isolated crossing field at Rutgers under the direct supervision of the breeder. This Breeders seed is used to establish an isolated "Foundation" increase field in Oregon which is grown under constant supervision of official state inspectors and hand rogued to remove any objectionable plant.

Certified seed must be grown only from Foundation seed in isolated fields. These fields must be essentially free from contamination by other ryegrasses and weeds and maintained according to certification standards.

The fluorescence test has been widely used in seed-testing laboratories for many years to distinguish between annual and perennial ryegrass. The seedling roots of annual ryegrass normally secrete a substance which shows a brilliant fluorescence under ultraviolet light. This characteristic results from a single dominant gene present in most annual ryegrass plants. Because this dominant gene can also be found in occasional plants of common perennial ryegrass and many of our older varieties, seed analysts and control officials have not been able to use this test as precisely as desired in their efforts to detect annual ryegrass contamination of perennial ryegrass seed (Nyquist 1963).

Breeders of some of the new fine-textured varieties of perennial ryegrass such as Pennfine and Manhattan realized the importance of being able to precisely detect any contamination of seed lots by unsightly annual ryegrass. With the helpful cooperation of seed analysts, these new varieties have been bred to be completely free of the dominant gene causing fluorescent seedlings. Any fluorescent seedling appearing in a seed lot of Pennfine or Manhattan immediately signals contamination. Therefore, plant breeders, quality conscious seed producers, certification agencies and seed control officials have one more tool to use in their joint efforts to provide the buying public with a superior product."

REFERENCES

1. Funk, C. R., R. E. Engel and P. M. Halisky. 1969. Registration of Manhattan perennial ryegrass. Crop Science 9:679-680.
2. Nyquist, W. E. 1963. Fluorescent perennial ryegrass. Crop Science 3:223-226.

Flourescence In Ryegrass Certification

By E. E. Hardin

After a variety has been developed through selection and/or breeding, production and market development are the next steps a variety must take on its way to the consumer. In order to grow a certified variety of perennial ryegrass in Oregon, the grower must plant Foundation seed stock on land which has not grown nor been seeded to any other perennial, ryegrass during the previous five years, unless the previous crop was of the same variety and passed the certification requirements. The field must also be free of *L. multiflorum*, and there must be adequate isolation to prevent crossing from outside pollen sources. A certified seed field must pass a Seedling inspection within sixty days after the initial planting, and a Seed Crop inspection prior to harvest of each crop.

The certification inspector looks for out of place and off-type seedlings of other ryegrass as well as isolation infractions during the pollination period. After harvest, a lot of seed must meet the mechanical purity requirements as established by the Seed Certification Service.

It is the intent of all concerned

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These seedlings are about six weeks old. Note the differences in color and height. The Manhattan and Pennfine varieties are fine-leaved, shorter growing and darker green. Photo was taken by Dr. C. Reed Funk.

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with the production of seed to see that high standards are maintained in the various steps of production. This assures the ultimate consumer the best possible product when he seeds his turf. Seed testing is that step in production which critically examines the seed for physical impurities. This information appears by law on all containers being offered for sale.

To the extent possible, seed analysts examine the seed for mixtures of other similar kinds of seed. For the best assurance one should use certified seed. Under such a program, a certification agency carefully documents the pedigree of the seed and supervises the growing conditions to prevent outside contamination. It provides an unbiased person to keep a check as the crop is growing.

Once the seed is harvested, cleaned, and in the bag, a sample is drawn and sent to a seed testing laboratory for a detailed analysis. Some seeds or seedlings have characteristics which differentiate them from other kinds. This becomes a useful laboratory method of detecting contamination. The fluorescence of annual ryegrass roots when observed under ultraviolet light is one of these characteristics.

Generally, perennial ryegrass roots do not fluoresce under the same light. Consequently, these two kinds can be separated on this basis at a very early stage of their development.

Four hundred seeds are planted on white filter paper and provided optimum conditions for germination. Complete germination is usually accomplished within fourteen days. The roots of these same germinated seedlings are observed under ultraviolet light and recorded as a percent of fluorescence or non-fluorescence. This information is then calculated into the purity reflecting any contamination which may be present.

New ryegrass varieties being developed do not necessarily exhibit this same fluorescence, but exhibit their own characteristic pattern. This pattern remains useful because once it is established it remains relatively constant, acting similar to a finger print. Any deviation from this pattern indicates the presence of contaminants. All of which provides us with more tools in our endeavor to provide information which allows the ultimate consumer the opportunity to buy the quality of seed he desires.

Flourescence And The Federal Seed Act

By C. R. Edwards

Conscientious seed producers take a great deal into account when producing certified seed especially of the new turf-type perennial strains. It is, however, also evident and relatively easy for less discriminating growers to produce noncertified

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Comparison of Manhattan perennial ryegrass and annual ryegrass. Note that the Manhattan is finer-leaved and not as tall as the annual ryegrass. The annual variety is generally light green and stands more erect making excellent hay or forage. Photo is by Dr. C. Reed Funk.

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seed of some of the new unprotected strains under conditions much less than desirable, with the end results being the production of noncertified varieties containing contamination from *L. multiflorum* either from crossing because of pollen sources to close to the seed production field, or from physical contamination of *L. multiflorum* actually being produced in the same field.

Although it is not mandatory to express the percentage of fluorescence or non-fluorescence on the purity analysis label, the expression of the percentage of fluorescence may be of value to the seed handler, the dealer, or the ultimate consumer. If contamination exists and is not expressed on the purity analysis label, violations of the various state seed laws or the Federal Seed Act may exist.

Generally, perennial ryegrass, as one of its characteristics, contains a small percentage of fluorescent seedlings; most of the seedlings are non-fluorescent.

When dealing with such perennial ryegrass, do seed law enforcement officials consider the small percentage of fluorescent seedlings to be perennial ryegrass? Yes.

Under Federal Seed Act testing rules, allowance is made for that small percentage of fluorescent seedlings. They are considered to be perennial ryegrass.

But, what if a breeder develops a new variety of perennial ryegrass which, as one of its characteristics, has totally non-fluorescent seedlings? Manhattan perennial ryegrass is such a variety. None of the seedlings are fluorescent.

What would Federal Seed Act officials do if, in their enforcement work, they tested a sample of seed labeled Manhattan, but found some fluorescent seedlings? Such fluorescent seedlings would not be considered Manhattan. In calculating the percentage of Manhattan perennial ryegrass, all fluorescent seedlings would be excluded. If the percentage of Manhattan, as so calculated, was beyond the tolerance that Federal Seed Act officials must apply, the seed would be falsely labeled.

Revised Tree Ordinance Booklet Now Available

The International Shade Tree Conference, Inc. has recently revised the publication entitled "A Standard Municipal Tree Ordinance".

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