

### *Meeting of the Northwest Scientific Association*

R. F. E. Sier, President of the Northwest Scientific Association, announces that the annual meetings for 1949 in Spokane, Washington, will be held December 28-29 instead of December 27-28 as originally scheduled.

A record turnout is anticipated for 1949 with every prospect for scientific presentations and discussions of an unusually high caliber.

Of special interest are: three sessions for section meetings instead of two; a luncheon-business meeting December 29; a \$100.00 prize award to the graduate student presenting the best paper; and a \$100.00 research grant.

J. W. Severy, Chairman of the Resolutions Committee (Head, Division of Biological Sciences, Montana State University, Missoula, Montana), urges members to send him their suggestions for resolutions, which he must receive before noon, December 28.

### *Research Grant*

A research grant of \$100.00 will be made by the NORTHWEST SCIENTIFIC ASSOCIATION to assist research under way in any one of the fields represented by sections in the Association. These are: bacteriology, public health, botany, zoology, chemistry, physics, mathematics, engineering, industrial sciences, forestry, geology, geography, social sciences, and soil conservation.

Applications for this grant must be filed with H. T. Gisborne, Chairman of the Board of Trustees, United States Forest Service, Missoula, Montana, before December 1, 1949. The application must describe the purpose of the research, its present status, plan for 1950, and the exact use to be made of the \$100.00 if it is granted. The Trustees will announce the recipient of the award at the Association's annual meeting, December 28-29, 1949.

### *Should the Association Change Its Place and Time of Meeting?*

There have been a number of requests for consideration of a change in the place and time of the annual meetings for the Northwest Scientific Association.

A discussion on this subject will be held at the regular business meeting, December 29, 1949, during the annual sectional meetings at Spokane. The discussion has been proposed because of the present conflict in meeting dates with those of the meetings of the American Association for the Advancement of Science and the possible desirability of meeting at the various member-institutions.

It will facilitate discussion and a satisfactory solution if members will come prepared to present their views at the business meeting.



### *Grass—A Wearing Surface for Airport Landing and Taxi Strips in the Northwest*

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WITH THE CONSTRUCTION of a network of small airports throughout the nation, there is a need for grass which will satisfactorily serve as a wearing surface on landing strips and taxiways. Communities, towns, and individuals who will be building small airports will usually lack the funds to construct hard-surface trafficways. By using grass for a wearing surface and thereby keeping costs to a minimum, more airports will be constructed and the airplane will serve an ever-increasing number of people. Thus grass, already serving mankind in a number of vitally important functions, varying from the preservation of soil and moisture to the beautification of our homes and parks, adds another important activity to its list of multiple uses.

Grass has been associated with aviation since the early days of flying. In its infancy, the airplane used pastures, hayfields, and meadows for landing areas. This kind of vegetative cover seldom gave satisfactory service. As planes increased in size and commercial flights were inaugurated, cement, black-top, and gravel came into use as a wearing surface on some airports in order to provide all-weather use for scheduled air carriers with heavy gross loads.

Most airports which have scheduled air carrier and cargo service have runways designed to support gross loads greater than 30,000 pounds. Until recently, Civil Aeronautics Administration design standards have limited turf

wearing surfaces to airports with anticipated gross loads of 10,000 pounds or less. However, under a recently issued Technical Standard Order, it has been promulgated that runway and taxiway pavements may be eliminated where turf surface and soil conditions will permit satisfactory year-around operations without such paving. Paved starter strips, warm-up pads, and loading aprons may be used in lieu of complete paving where considered adequate. Under this system it is expected that turf wearing surfaces for runways will prove to be entirely adequate at many locations for gross loads up to 30,000 pounds and in some instances for even heavier loadings.

Through the National Airport Plan, improvements will be made to existing airports and about 3000 new civilian ones constructed. The majority of new airports will be for light- to moderate-weight planes. Airports for most small aircraft will have grass wearing surfaces wherever conditions are favorable for airport turf. Turf trafficways are preferred for small airports for five reasons: (a) *Lower construction costs.*—Yarrow, in *Airports Magazine*, August, 1945, reports: "Actual construction costs, for the nation as a whole, for turf surfaces for airports have varied from \$50 to \$750 per acre; bituminous surfacing \$4,000 to \$15,000; and concrete \$9,000 to \$20,000. These costs for all three types of surfacing do not include sub-grade, base course or drainage construction." (b) *Lower operating costs for planes.*—Tires have to be replaced more frequently on planes operating from hard surfaces. Fuselage and wing coverings are often torn and propellers nicked by loose gravel. (c) *Safer flying.*—Chances for ground looping are reduced. (d) *Better depth perception.*—It is easier to judge height above grass than from a hard surfaced area. Turf fields do not reflect as much light as hard surfaces. (e) *Lower maintenance costs.*—Cost of keeping turf surfaces in good operating condition is only a fraction of the cost of maintaining hard surfaces.

During the war many Army and Navy air training programs were conducted from turf surfaces. Prior to World War II, grass had not been extensively used as a wearing surface for wheel traffic. Nor is it the intent of this paper to evaluate or report upon any accomplishments in this respect. But, during the past fifteen months the authors have been studying grasses used as a wearing surface on airports in Montana, Idaho, Oregon, and Washington. The purpose of this presentation is to point out briefly the kind of turf desired and factors to consider in its establishment and management on airports. Turf as discussed herein refers to plant cover grown on the traffic areas of airports.

## REQUIREMENTS OF AIRPORT TURF

GRASS, TO BEST FULFILL the requirements of an airport turf, should possess the following prerequisites: long life; short top growth; dense, tight sod; durability and resistance to surface wear; ability to increase substantially the soil stability; short germination and establishment period; extensive and deep root system; non-susceptibility to disease and to insect damage; rapid recovery from surface scars and periods of dormancy; easily obtainable stands; and commercially available seed. These requirements are similar in some respects to those for specialized grasses used for agricultural and landscaping purposes. They differ to some extent in the amount of top growth; resistance to physical wear, and soil stabilizing properties.

In the Northwest, no one grass is known to have all of these characteristics. Some qualify better than others. Of the many grasses used for agricultural and turf purposes in the Northwest, it is believed the fine-leaved fescues come closest to fulfilling the above specifications. The fine-leaved fescues, creeping, chewings, and sheep fescue, under optimum growing conditions, make a dense, moderately low-growing, tough turf. They are long-lived perennials free from serious disease. Superficial damage heals quickly. The roots are fine, densely matted, and fairly deep. Measurements made by the Soil Conservation Service Nursery at Pullman, Washington, show that the fine-leaved fescues produced a root system that exceeded in weight all other grasses studied. Because of their resilient turf and voluminous fibrous root systems, they should have good soil stabilizing properties. Their capacity to withstand wheel compaction and traffic is not known, but is suspected to be good.

Although the fine-leaved fescues are outstanding examples of turf grasses, their areas of adaptability in Oregon, Washington, Idaho, and Montana are limited. Where they cannot be grown, those grasses which are adapted and most nearly typify the fine-leaved fescues should be selected. Wide departures from this ideal must necessarily be made in areas of low rainfall. Generally, the wheatgrasses—crested, intermediate, and western—"streambank" (1), and smooth brome will make the best turf under arid and semi-arid conditions. Blue grama and buffalo grass, both excellent turf grasses, are adapted to airports located in eastern Montana. The bentgrasses are naturally adapted for the high rainfall areas west of the Cascades. Their dura-

bility as a wearing surface and their soil stabilizing properties are believed to be less than the fine-leaved fescues.

The principal utility of grass has been, up to now, for purposes other than durability under wheel traffic and as an adjunct to stabilization of soil. It is doubtful if the plant geneticist ever considered improving grass to enable it to compete with, or substitute for, inorganic wearing surfaces. It is possible, of course, that some grasses more suitable for airport turf than any we have now have been overlooked. The airplane, at least small aircraft, has opened a new horizon for the utility of grass. Turf grasses will play an important role in the network of airports that are proposed under the National Airport Plan. They would play a bigger role, if data obtained from carefully conducted experiments were available on the durability of turf grasses to wheel traffic and their capacity to increase stability of different soils. Grass roots have a mechanical binding action upon the soil, thereby increasing the shearing strength and stability. It is not known, for instance, what the soil stabilizing properties of a creeping fescue turf are when established on a fine sandy loam soil, or the capacity of smooth brome to increase the stability of a sandy silt loam soil. Will Fairway crested wheatgrass, in a 15-inch precipitation zone, produce a sufficient ground cover and root system on a gravelly silt loam to provide an all-weather landing surface for gross loads up to 5-, 10-, or 15-thousand pounds? Do the larger, coarser, but more shallow-rooted grasses, such as quackgrass, smooth brome, or saltgrass, have better soil stabilizing properties than the denser, deeper fibrous root systems of fine-leaved fescues, crested wheatgrass, and Kentucky bluegrass?

#### ESTABLISHMENT OF TURF

ESTABLISHING AN AIRPORT turf is similar to seeding grass for any purpose where a good stand is desired. Each operation must be thoroughly and accurately done if best results are to be obtained. Usually there is only one opportunity to establish a turf on airport traffic areas and that is the initial seeding. Public demand for use of the airport after it has been in operation makes it difficult to consider closing the airport for several weeks in order to do another establishment job. Therefore, every seeding job must be carefully analyzed, every precaution must be taken, and every agronomic tech-

nique must be used in order to assure the establishment of the best possible turf from the first seeding.

Adequate surface and internal soil drainage as well as accurate grading are fundamentally basic to the development of a satisfactory turf on airports. Surface drainage can be provided by interception ditches if needed, and by constructing a crowned traffic area that has from 1.5 to 2 per cent transverse slopes. Water drains slower from grassed areas than from barren areas; thus sufficient slope is required to facilitate removal of surplus water. Adequate internal soil drainage is of equal importance with surface drainage in providing all-weather stability of turfed surfaces. If the landing area does not have a soil with a favorable infiltration ratio, the necessary granular material must be blended with the soil to improve the drainage and increase the stability. Close collaboration with airport engineers is required at all times to determine the needs for soil stabilization and drainage. In areas of high rainfall and severe frost action, base material is often required under a blended topsoil.

After final grades are established, the area should be worked with a float or land leveler. Final slopes should be smooth and uniform. Ruts and depressions or any area that will impound water are to be avoided. The importance of correct grading and land leveling to attain adequate surface drainage cannot be overemphasized for turf trafficways. During construction operations, topsoil may be buried leaving a poor quality subsoil on the surface. Where adequate moisture occurs during the growing season, the necessity for topsoil in obtaining a good stand of grass is reduced. But ample quantities of fertilizers and a mulch must be used. In areas of adequate summer rainfall, the value and need for topsoil increases if a satisfactory turf is to be obtained.

The preparation of the seed bed is all-important. Soil conditions need to be as perfect as possible in order to induce quick germination. A fine, firmly compacted, uniform seed bed free of air pockets, large rocks, roots, and limbs should be made. Firmness of seed bed should not be as difficult to obtain as on agricultural lands. Generally, both surface and subsurface soil will have good density due to grading and construction operations. In addition, some soils will require blending and compaction in order to improve stability. In fact, the first seed bed operation may often be one of breaking up surface compaction.

Fertilizers should be applied in advance of seeding and thoroughly distributed throughout the seed bed. The kind and amount of fertilizer used will depend upon the elements lacking in the soil, moisture conditions, planting period, and fertilizers available. In many cases, both organic and inorganic fertilizers are required to assist in rapid seed germination and establishment. Nitrogen is usually the critical element. Liberal quantities of nitrogen are required because it is readily absorbed by a healthy turf and lost by leaching. While favorable results are usually obtained from heavy applications, precaution should be taken against over fertilizing, resulting in the development of a shallow root system and a succulent top growth.

When construction of the landing strip is completed, there is always a demand for its immediate use. Airport seedings seldom have a chance to develop into a true turf before it is used as a wearing surface. Thus the necessity for proper seed-bed preparation and a fertile soil medium. Liberal quantities of available essential nutrients are required to force rapid establishment and promote a vigorous turf.

Seed should be sown with a grass drill or wheelbarrow seeder. Uniform distribution of seed and proper depth of planting is of utmost importance with all turf seedings. Because of the wide spacing between rows, grain drills should not be used unless cross or tandem drilling is made. To obtain the maximum ground cover in the shortest time, seed must be uniformly distributed over the surface. This will require a seeding rate somewhat higher than when grass is used for agricultural purposes.

The permanent turf grasses should always be sown in pure stands. They should not be mixed with so-called "nurse crops" or temporary grasses, a common practice in other plantings. The fast-growing, but short-lived grasses and grains work to the disadvantage of the turf species when seeded together. They make a rapid start and provide a good ground cover in a short time, thereby giving the erroneous impression to the airport operator and flyers that a good turf has been started. But they seriously compete with the slower growing but long-lived turf species. It has been observed by many technical workers that domestic and perennial ryegrass, when sown with slow-growing permanent grasses, have hindered rather than helped to obtain stands of the desired grasses. Erdmann and Harrison (2) report that domestic ryegrass

and redtop, because of rapid initial growth, seriously inhibited growth of Kentucky bluegrass and chewings fescue when sown in a mixture. Unfortunately, perennial ryegrass has been widely sown for turf on airports in the Northwest. It has been seeded straight and as a companion grass in mixtures. In mixtures, wherever conditions were favorable to its growth habits, it has dominated the long-lived, slow-growing turf species. It soon thins out and is replaced by weeds or nonturf plants. The shallow root system and bunchlike growth of perennial ryegrass are other reasons why it should not be used except in temporary seedings.

The aggressive temporary grasses and certain cover crops may be planted, in some instances, to precede the permanent turf seeding. Construction work is often completed at a time unfavorable to planting of permanent turf. Dust may be serious unless a ground cover is grown to protect the traffic surface. Under some conditions soil erosion on newly graded areas could cause washing. This would require another grading and leveling operation before a permanent turf could be sown. In such instances, cover crops or temporary grasses are useful in preserving established grades and controlling dust until it is proper time to sow the permanent grasses.

Airport turf seldom has an opportunity to grow a good sod and a supporting root system before used for flight operations. There usually is a demand for the field as soon as final grades are established. When grass is used prematurely, traffic hinders and retards establishment and creates scarred and barren areas which never have an opportunity to heal. With continued use, these areas increase in size and cause unwarranted criticisms of turf as a wearing surface. Turf must be given an opportunity to become established before using, if it is to give good service. Where an adequate establishment period cannot be provided, prior to serving as a wearing surface, then a portion of the area should be seeded to temporary grass. Operations can begin immediately off of the temporary seeding and continue until the permanent turf is ready for use. Then traffic can be switched to the established seeding and the temporary grasses replaced with permanent turf. Used in this manner, the aggressive fast-growing temporary grasses or cover crops play a useful and beneficial role in the establishment of permanent airport turf.

## MANAGEMENT

SEVERAL SCORE of supposedly turfed airports in Oregon, Washington, Idaho, and Montana have been carefully inspected and studied during the past year. Very few show any real turf management. Some have been planted and forgotten. Clipping once or twice a year is practiced on others. The great majority of turf fields, good and bad, were a happenstance of nature and have never been seeded or treated in any manner conducive to the production of a good turf. It is with both gratitude and faith that we analyze our findings—gratitude to realize that grass has performed so well in spite of the handicaps imposed, and faith that airport turf will exceed the expectations of everyone when properly planned and managed.

If turf is to perform its function properly, as an airport wearing surface and stabilizing agent, it must be given timely care consisting of fertilizing, mowing or clipping, rolling, weed control, rodent and disease control, and filling of ruts and low spots. It is cheaper to maintain turf than to repair it.

*Fertilizing.*—Generous amounts of commercial fertilizers are required to keep the turf in a vigorous condition. Airport sites are usually selected, due to lower land costs, where the soil has little agricultural value and consequently is of low productivity. Furthermore, the topsoil is often buried during construction or is blended with granular material to obtain stability. Thus the medium on which the turf is grown is low in fertility and requires the addition of essential plant nutrients in order to make a strong growth. However, regardless of whether the medium consists of sand, topsoil, subsoil, gravel, or an admixture, a fertilizer program should be followed that is based upon supplying essential nutrients which are lacking or of insufficient quantity in the soil.

The quantity of, and frequency with which, fertilizers are applied will vary with the amount of precipitation, soil productivity, grass species, and amount of traffic. The applications required, however, will be with greater frequency than customarily used on agricultural crops. Split applications are believed to be desirable on most sites if maximum fertilizer utilization and plant growth are obtained. Organic fertilizers, such as activated sludge or peat, are preferred on sites which have a sand or gravel mixture or subsoil for a seed bed. Organic fertilizers, due to their moisture-retentive qualities, have added significance in areas of low rainfall.

*Mowing.*—The principal objective of mowing is to aid in the development of a dense and durable wearing surface and in a vigorous root system. It does not involve giving the grass a shave. There is no need to keep it clipped as short as a golf green. Mowing is of primary importance on a newly seeded area in that it controls annual and biennial weeds and encourages tilting and the formation of a quick low-growing ground cover.

Clipping is also beneficial in other respects: (a) It reduces the formation of tussocks or tufts of nonsod-forming grasses. Alta fescue, in pure stands, for instance, will make a good uniform wearing surface provided it is kept clipped to a height of about 4 inches. If not clipped frequently, it will form tussocks, creating a rough and unsatisfactory landing strip. (b) It reduces fire hazard. (c) It acts as a fertilizing agent and reduces moisture evaporation when clippings are left on the ground as a mulch. (d) It reduces transpiration, an important factor in areas of high temperatures and little rainfall during the growing season.

Height of clipping will range from 3 to 4 inches in humid areas, to 5 to 6 inches in arid zones. Grass clipped closer than this will be invaded by weeds and undesirable grasses and develop a weak root system; it will be more susceptible to erosion and probably less resistant to wear.

The reel type gang mower, on short growing vegetation, has given meritorious service at a cost of only a few cents per acre. The sickle bar mower is slower and more costly to operate than the reel type.

*Rolling.*—Rolling is usually beneficial to an airport turf wherever the ground freezes. In most soils frost action causes the plants to be heaved slightly above the ground surface. This is especially true in the winters immediately following seeding before the root system has been adequately developed. Rolling is also beneficial wherever rodents have been active. In the seedling stage or before a good turf has developed, rolling should be done with a weighted culti-packer. A mature turf requires a pneumatic wobble-wheel roller for best results. The three-wheel or tandem power roller having a fixed weight is usually too heavy for turf. Rolling should be done at the optimum soil moisture content.

*Weeds.*—Weeds reduce the stabilizing capacity of a turf. The composition of a good turf should have only a minor percentage of weeds. The invasion of weeds can be minimized by following a good turf-management pro-

gram. Most weeds not checked by mowing and a good healthy turf can be controlled by the use of selective weed-killing chemicals.

*Filling of ruts and low spots.*—Low spots, ruts, rill erosion or places wherever water accumulates should be filled. If the depressed areas are of any depth, the lower layers should be compacted. The filled areas should then be fertilized, tilled, and seeded. Where traffic is such that the turf on the reseeded areas will be slow in developing, sod should be used. Airports that have turf wearing surfaces should maintain a sod nursery. Then, when the turf receives bad scars, is torn, or otherwise injured to a degree where recovery will be slow, segments of sod can be cut from the nursery and transplanted.

*Rodents.*—The control of rodents on some airport turf often assumes a maintenance operation of first importance. Their mounds and burrows make traffic areas rough and also weaken the turf.

#### SUMMARY

TURF WILL BE USED as a wearing surface on hundreds of small airports which are being planned and developed with financial and technical assistance under the National Airport Program. Turf is usually preferred on small airports because of economy of construction and maintenance, lower operating cost of airplanes, and safer landing conditions for inexperienced pilots. During the war many Army and Navy flight training programs were conducted satisfactorily from turf fields.

An ideal airport turf should be long lived, have a short top growth, produce a dense tight sod with an extensive root system, be durable and resistant to surface wear, substantially increase soil stability, have a short germination and establishment period, be quick to recover from surface scars and periods of dormancy, and have commercially available seed.

The fine-leaved fescues, including creeping, chewings, and sheep, are the only grasses adapted to most of the Northwest which approach the ideal characteristics of an airport turf grass. Other less desirable species have to be used where the fescues are not adaptable.

A seed bed for airport turf must be prepared as agronomically perfect as possible with consideration for drainage, crowning, surface smoothness, soil condition, soil stability, climatic conditions, fertility, time of seeding,

weeds, moisture, and species to be seeded. The use of short-lived grasses should be avoided in long-lived turf mixtures as they affect detrimentally the ultimate stand of the permanent turf species. Short-lived grasses should be seeded only for temporary turf where necessary.

If turf is to perform its function properly as an airport wearing surface and stabilizing agent it must be given timely care consisting of fertilizing, mowing or clipping, rolling, weed control, rodent and disease control, and filling of ruts and low spots. It is cheaper to maintain than to repair turf.

#### LITERATURE CITED

- (1) Stark, R. H., J. L. Toevs, and A. L. Hafenrichter. 1946. Grasses and cultural methods for reseeding abandoned farm lands in southern Idaho. Univ. of Idaho Bull. 267.
- (2) Erdmann, E. O., and C. M. Harrison. 1947. The influence of domestic rye grass and redtop upon growth of Kentucky bluegrass and chewings fescue in lawns and turf mixtures. Jour. Amer. Soc. Agron. 39: 682.