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Iron Sulphate

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EDITOR'S NOTE: WE ARE SINCERELY INDEBTED TO MR. ERB FOR HIS EXHAUSTIVE AND ACCURATE DISCUSSION ON THE USE OF IRON SULPHATE IN ITS RELATION TO THE GROWTH AND DEVELOPMENT OF FINE TURF. IT HAS BEEN THE UNIVERSAL BELIEF THAT IRON SULPHATE WAS ONLY USEFUL IN THE ERADICATION OF WEEDS. BUT MR. ERB HAS DELVED MORE DEEPLY INTO THE SUBJECT AND HAS DISCOVERED THROUGH SOURCES OF AUTHORITY THAT IRON IN THE SOIL IS NECESSARY FOR HEALTHY PLANT GROWTH. WE WOULD APPRECIATE AND BE GLAD TO PUBLISH COMMENTS FROM OUR READERS ON THIS SUBJECT.

IRON sulphate ($FeSO^4$), also called copperas and green vitrol, is, as the chemical formula signifies, a combination of iron, sulphur, and oxygen. In summarizing the available material on the value of iron sulphate in relation to the growth of golf course grasses, we find it being used in two general ways.

In America, iron sulphate is used as an eradicator of weeds. In England, iron sulphate is used not only as an eradicator of weeds, but also as a valuable factor in the production of the fine golf course grasses.

IRON A VITAL ELEMENT TO THE GROWTH OF GREEN PLANTS

IRON is an element of vital importance to the growth of green plants. A certain amount of iron seems necessary as one of the factors in the normal development of chlorophyll (leaf green), although it is not regarded as a constituent of the organic bodies which make up this substance. Lack of iron is one of the many conditions leading up to pathological chlorosis.

Chlorosis may be described as a disease of the chlorophyll, or the green parts of the plant. Cultural experiments have shown that a plant cannot develop normally in the absence of iron. Artificial chlorosis has been produced in plants living in a soil where iron has been excluded. While the seed may germinate, and the young plant at first grown normally, it later goes into a bad condition unless iron is supplied.

It may be that the lack of iron effects the protoplasmic structures in which the chlorophyll is deposited, for the best evidences point to the use of iron by every living cell, including those organisms which contain neither the pigments nor allied compounds. The absence of green in plants deprived of iron has given rise to the idea that iron takes part in the formation of the chlorophyll, but we are far from knowing what is the role of iron in the formation of chlorophyll. It was once believed that iron entered into the composition of chlorophyll, but this opinion is not entertained at this time.

We therefore conclude, that iron is a vital element to all green plants, that it may be said to be present in all green parts without being absent in the other parts of the plant; that its absence is one

of the many conditions leading up to pathological chlorosis.

An interesting observation by Bourcart, a French scientist, is worthy of citing: "Plants that undergo their classical treatment of Bordeaux Mixture, likewise those which are treated with green vitrol (iron sulphate), acquired vitality which increases assimilation (starch-making function of the plant), and which enabled trees to preserve their leaves longer in the autumn than those untreated."

It has been found that the same dose of iron has a different effect on different types of plants. Plants very fond of water are much more sensitive to iron sulphate than plants not fond of water. Mosses for example, feel the action of iron sulphate more than grasses. It can then be said, that the injurious nature of an application of iron sulphate depends greatly on the nature of the plant to which it is applied. If certain doses of iron sulphate be exceeded, the iron is injurious to the plant, if given in still greater quantity it is mortal.

According to Bourcart, iron sulphate may be used in many different ways. In cultivation it is spread as crystals, or in solutions by watering carts; it may also be mixed with soil and broadcast by hand or machine. To cure trees of chlorosis, the iron sulphate may be sprayed on the plants or injected into the trunks of trees. When used by injection the action is felt much quicker than when it is absorbed by the roots.

ERADICATION OF WEEDS WITH IRON SULPHATE

THE principal use of iron sulphate in America today is to eradicate weeds in turf, particularly dandelions. Experiments have been conducted by many of the State Experimental stations in the use of iron sulphate as a weed spray, and they have met with success with certain weeds.

In New York Experimental station bulletin, No. 466, by M. T. Munn, explains the general method used in the United States to eradicate dandelions from turf. Summarizing the literature on the experiment: "Dandelions can be eliminated from lawns by the use of iron sulphate sprays at very little cost and without material injury to the grass. Four or five sprayings of the iron sulphate solutions are generally required to obtain the desired results. The first spraying should be made just before the blooming period in May, when the plant is pushing out its buds; the other sprays should follow at intervals of three or four weeks. Spraying should be discontinued in the hot dry weather of the summer. The spraying can be renewed in the late summer and fall. While a conspicious blackening of the turf will appear following the application of the spray, it will soon disappear."

The spray solution is prepared by dissolving one and one-half pounds to two pounds of iron sulphate in each gallon of water. According to the New York Experimental station, the weaker solution appears to be entirely satisfactory, and probably the one to be preferred. When the solution is used at this strength, the quantity of iron sulphate required for one application is four pounds per 1,000 sq. ft., or approximately 175 pounds per acre. A gallon of solution will cover 375 sq. ft. of lawn.

The degree of effectiveness of the spray on the dandelions has been found to depend to a great extent upon the manner to which it is applied. The best results are secured when the solution is driven in the form of a mist-like spray down among the foliage. While fairly satisfactory results may be expected when the solution is applied with a common sprinkling can, it is recommended that some sort of a spray pump be used. If a poor quality of iron sulphate is being used, it should be strained through a fine strainer or two thicknesses of cheese cloth to remove any particles that would clog up the nozzles of the sprayers.

According to the Massachusetts Experimental station leaflet, No. 78, by O. L. Clark: "Grain fields infested with wild mustard, wild radish, small ragweed, pepper grass, pigweed, shepherd's purse, etc., may be freed from weeds to a large extent by the use of a 20% solution of iron sulphate (100 pounds of iron sulphate to 50 gallons of water). Great care should be used to secure a spraying outfit and nozzle which is adapted to applying the solution in a fine mist. The last cannot be emphasized too strongly because the whole value of the spray lies in its power to reach every part of the leaves, since it is the part of the plant above ground that is killed and not the roots directly.

If the solution is sprayed on in coarse drops it rolls off the plant with little or no effect. Perennial and biennial weeds are much more difficult to control than annuals because of their underground storage organs which are not killed by the spray. It is well to wait until the plants are just beginning to show buds before spraying, for at this time, all the seeds

in the ground will have germinated. It is also of special importance to spray on a clear day, and to spray at a time when fair weather is predicted for a day or two following, since the value of this treatment is much reduced if succeeded in a short time by a shower. It is customary to use 50 gallons of 20% solution of iron sulphate per acre."

IRON SULPHATE KILLS CHICKWEED

IRON sulphate has also been found by the Massachusetts Experimental station to kill chickweed and purslane after repeated sprayings. Heal-all, gill-over-the-ground, broad and narrow leaved plantain, have either been killed or badly injured by the spray. The iron sulphate will not kill crab grass and other weed grasses. It must also be remembered that it is injurious to white clover. Moss in lawns is often satisfactorily eradicated with a 15% solution of iron sulphate at the rate of 50 gallons per acre.

It should be noted here that iron sulphate produces a conspicious yellowish-brown-rust stain on cement, stone, woodwork, and cloth which is difficult to remove. It should also be remembered, that all metal containers used in mixing and applying of iron sulphate solutions should be thoroughly washed out to prevent corroding.

The New York and Massachusetts Experimental station recommend the supplementing of the spraying operation with fertilizing and seeding of the bare spots recently vacated by the weeds.

USE OF IRON SULPHATE IN ENGLAND

THE following part of this paper is devoted to the use of iron sulphate in relation to the maintenance of golf turf in England. The following information has been obtained from the Journal of Greenkeeping Research, issued by the British Golf Union. The British Golf Union maintains the St. Ives Research station, at Bingley, Yorkshire, under the direction of R. B. Dawson.

Concerning the use of iron sulphate on golf turf in England, Mr. T. W. Evans of the St. Ives station states: "The beneficial effects observed from an application of iron is difficult to explain. The part that iron plays in plant metabolism is vague. Thus it promotes the production of chlorophyll (the green pigments of plants), in grasses and yet is not a constituent of that complex compound. From numerous plots at the Research station, however, it can be seen that the addition of iron sulphate to sulphate of ammonia induces an acid reaction in the soil; leads to a quicker reduction of weeds; and at the same time imparts a beautiful dark green color to the turf, thus counteracting the chlorotic condition which is often observed when sulphate of ammonia is used alone."

Mr. Evans continues: "The addition of sulphate of iron has also been shown to encourage fine leaved Sheep's fescue in mixed sward (turf), and it is interesting to compare this with the practice of heavily sanding greens with the object of encouraging finer grasses. As previously stated, sanding builds up an infertile top layer while sulphate of iron reduces the fertility of the existing top-spit by tending to make the plant nutrients less available."

In partial explanation of the sanding of greens, mentioned by Mr. Evans, in the above paragraph: It has been found in England that the fine turf grasses, bents and fescues, often grow in infertile acid soil composed of large amounts of sand. They maintain that on many of their best seaside courses, the top four inches of the greens are composed almost entirely of sand and are therefore infertile. The Journal states that this is not a new idea, but simply a tentative suggestion to explain what has long been known to old experienced greenkeepers, that "sand fines down the grass." The Journal states: "Good greens however, cannot be produced simply by sanding, since its action is merely mechanical, and also serves to build up an infertile top-spit suitable to the growth of the finer turf grasses. Having established the finer grasses, they must regularly be supplied with quickly available nitrogenous fertilizers such as sulphate of ammonia, etc."

ECONOMY IN CUTTING NECESSARY

THIS leads us to another peculiar aspect of British greenkeeping which is intimately related to iron sulphate. The St. Ives station is conducting experiments in fertilization and top-dressing to find a method by which a better sward can be produced without resulting in consequent oftener cuttings. To quote Mr. Dawson: "Very few clubs will deny that the best top-dressing for a green is sulphate of ammonia mixed in an adequate compost, but this system is regarded by disfavor in some clubs because of the extra growth, which results in extra cutting. In view of the facts obtained in this preliminary investigation however, it seems possible that the top-dressing with sulphate of ammonia and

sulphate of iron not only results in a good sward, but also a decrease in productivity. The importance of this cannot be too strongly emphasized since frequent cutting is costly."

The St. Ives station has conducted a very interesting experiment in the eradication of weeds on old turf. For purpose of the experiment an old weedy lawn adjoining the station was used. An area 18 square yards was marked off and then divided into three equal plots. The only grass on these plots was A. Tenius (Colonial Bent). The following weeds were present:

Creeping Buttercup
White Clover
Daisy
Mouse-eared Chickweed
Moss (2 species)
Pearlwort
Ribwort plantain (lanced-leafed plantain)
Self-heal (prunella vulgaris)
Sheeps sorrel (sour grass)
Yarrow

The treatments were as follows:

Plot No. 1. Check.

Plot No. 2. Sulphate of ammonia and sulphate of iron mixed with one-half ton of soil. Mixture: 150 pounds of sulphate of ammonia per acre, 50 pounds iron sulphate per acre

Plot No. 3. Lime applied one-half ton per acre.

Each plot was treated four times in 1929:

First application, Aug. 8, 1929.
Second application, Aug. 20, 1929.
Third application, Sept. 2, 1929.
Fourth application, Sept. 21, 1929.

The applications were broadcast by hand and no particular precautions taken as to weather conditions. According to the article, eradication of weeds by this method is usually more effective if the applications are made during dry weather. In the case of this experiment however, rain followed the second and fourth applications. No scorching occurred at the above rates of application.

RESULTS OF THE ENGLISH EXPERIMENT

THE results of the experiment in 1929 were as follows: On the sulphate of ammonia-sulphate of iron plot No. 2, the eradication of weeds was complete with the exception of creeping buttercup. The plants of that weed were small and damaged. Self-heal (prunella vulgaris) they found in particular to be very susceptible to the mixture of sulphate of ammonia and sulphate of iron. On plot No. 3, the lime reacted very favorably for the growth of weeds, especially self-heal. The percentage of moss was not decreased by the lime.

During 1930 none of the plots were treated. Plot No. 2, the sulphate of ammonia-sulphate of iron plot, still remained free from weeds with the exception of creeping buttercup, and a few plants of sheeps sorrel that had reappeared. The limed plot was covered with a dense, vigorous mat of weeds, even to a greater extend than the control.

According to other experiments and advisory work completed by the St. Ives station, it was found that in addition to the above weeds mentioned, birds trefoil, red clover, yellow suckling clover, and field speed well may be destroyed in a similar manner. Dandelions and cats ear, while more resistant can be eradicated. Creeping butttercup, mouse-eared chickweed, yarrow and pearlwort have to be placed usually in the resistant class. The St. Ives station also found that iron sulphate applied in excess quantities may cause considerable burning. This effect however, is generally only temporary.

SUMMARY OF MATERIAL COVERED IN THIS PAPER

IN SUMMARIZING the material on iron sulphate covered by this paper we find the following:

1—Iron sulphate may be used as a source of iron for plants.

2—Iron sulphate may be used as a cure of Chlorosis in plants.

3—Iron sulphate will control moss and many kinds of weeds in America.

4—In England the addition of iron sulphate to greens has been found to make the topsoil less fertile and to encourage the growth of fine grasses.

5—The addition of iron sulphate to sulphate of ammonia has in England been found to induce an acid reaction in the soil; lead to a quicker reduction of weeds; and at the same time impart a deep green color to the turf, thus counteracting the chlorotic con-

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Market Place *and* Buyers' Guide---

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Pro-greenkeeper with many years' experience, seeks position as professional, pro-greenkeeper or greenkeeper. Grandnephew of the late "Old" Tom Morris of St. Andrews, Scotland. References, John Ball, eight times British Amateur champion, and Jimmie Johnson, ex-American Amateur champion. Previous connections, Town and Country Club, Saint Paul; Midlothian C. C., Chicago; Louisville C. C.; Country Club of Harrisburg, Pa. Address Tom Morris, 1548 E. 64th Street, Chicago, Illinois.

Park and Cemetery Turf

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all times, and located on soil that will not crumble away when the sod is lifted.

If a wild grass that makes good turf creeps into the lots, tame it and encourage it to grow. Turf is what is wanted and not a particular species of grass. Rhode Island bent and many bent species very often volunteer in turf. The use of acid-reacting fertilizers is much more likely to encourage desirable native grasses to grow than fertilizers that give an alkaline reaction.

Iron Sulphate

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dition which is often observed (in England) when sulphate of ammonia is used alone.

In conclusion, it should be remembered, that the results obtained in England from the use of iron sulphate, have been obtained under cultural conditions that differ in many respects from those of the United States. It would be interesting to observe the results of similar experiments conducted under our cultural conditions.

Draining Polo Fields

By G. D. JONES, *Agricultural Engineer*

IN THE management of polo fields, golf courses, estates, cemeteries and aviation fields, unusual drainage problems of more than ordinary difficulty are frequently encountered. A typical case was that of the Hunting Valley polo field, located just outside of Cleveland, Ohio, in the Chagrin Valley.

This field had been under-drained with tile at the time it was made. Due, however, to constant rolling and hard use from regular play, the ground had become so compacted that surface water was unable to get through to the tile, and the latter, therefore, had lost its efficiency in maintaining good drainage. As a result, much loss from winter killing was experienced and the field was frequently unplayable at the time games were scheduled.

The problem was obviously the adoption of some method which would break through the top soil without injuring the turf or the playing qualities of the field, and at the same time would permit the surface water to drain through to the tile, where it could be carried away. The agricultural engineering department of the Cleveland Tractor company was consulted and a treatment recommended with results that have been unusually satisfactory.

In the fall of 1932 a Cletrac Model 25 crawler tractor was used to pull a No. 20 Killifer chisel over this field to a depth of approximately 20 inches. A special sweep-shaped tool was used at the bottom of the chisel to increase the fracture of the compacted soil at the bottom of the chisel cut. The cuts were run across the field at intervals of approximately 30 inches at right angles to the direction in which the tiles were laid. This treatment loosened the compacted top soil and permitted the easy passage of water to the lower levels, where it was carried away by the tile. No injury to the turf was experienced.

The effectiveness of the job was well illustrated one morning early in March, 1933. After a very heavy rain on this particular morning, all the fields in the