MINERAL DEFICIENCY SYMPTOMS IN TURFGRASS

By Dr. James R. Love • Associate Professor of Soils, University of Wisconsin

The foliar deficiency symptoms of major and minor nutrient elements for many agricultural and horticultural plants have been described and illustrated in the excellent publications listed at the end of this article. However, no mention of the nutrient deficiency symptoms in turfgrasses is given.

The purpose of this study, sponsored by the O. J. Noer Research Foundation, was to determine the foliar deficiency symptoms of the three major nutrient elements: nitrogen, phosphorus, and potassium; and of the three secondary elements: calcium, magnesium, and sulfur. Three cool-season grasses were used as the indicator plants: Seaside creeping bent, Merion Kentucky bluegrass, and Pennlawn creeping red fescue.

A similar study of the minor nutrient elements (iron, manganese, copper, boron, zinc and molybdenum) is under way and will be reported in Golfdom when completed. Bermuda grass will also be included in these investigations.

The grasses were grown from seed in sand cultures, using a complete nutrient solution until all plants were well established. It was found that unless the initial solution was complete the small seeded bent and bluegrass died from starvation while they were too small to clearly show any deficiency symptoms or else they failed to develop the signs that characterize the deficiency in the more mature stages of growth. The nutrient element under study was then removed from the feeding solution and the deficiency symptoms noted as they appeared. Each treatment was duplicated. The deficiency symptoms were produced three times to eliminate all mistakes. This was done by adding the deficient element to the nutrient solution and permitting the grass to recover its normal growth pattern. The element was again withheld until the deficiency symptoms reappeared. In every instance the visual symptoms were reproduced.

The symptoms were found to vary somewhat depending upon the extent of the shortage and the stage of growth at which the deficiency manifested itself. Calcium is a good example of the latter. When it was not added initially the roots of the young plant were stunted, black in color, and very gelatinous. None of these symptoms was observed in the calcium deficient grass after having been first established with the complete nutrient solution. The deficiency of calcium became so acute that one of the duplicates in the bluegrass series failed to recover after calcium was added to make the nutrient solution contain every one of the essential nutrient elements.

The following descriptions of the nutrient deficiency symptoms reveal a close similarity between those seen in Seaside bentgrass and Pennlawn fescue. Where differences exist in Merion bluegrass they have been noted.

A chemical analysis of the leaves revealed that those grown on deficient nutrient solutions contained from 50 to 75 per cent less of the element in question than leaves from healthy plants. This is based on an average of the three grasses. This is shown in the following table that lists the percentage of each element present in leaves of healthy and deficient grass plants.

	(% in leaf)		(% in leaf)
Nitrogen		Calcium	
Complete	.73	Complete	.75
Deficient	.38	Deficient	.21
Phosphorus		Magnesium	
Complete	.11	Complete	.17
Deficient	.05	Deficient	.06
Potassium		Sulfur	
Complete	1.18	Complete	.15
Deficient	.25	Deficient	.06

Since any description is a matter of individual judgment, the illustrations in the accompanying color plates should be studied carefully and used in making the final diagnosis along with a chemical test of the soil, a leaf tissue analysis, or both.

Nitrogen: The plants of bent and fescue are thin and erect, with almost no tillering. Leaves are short and small. In the early stages the color is a pale green. As starvation progresses the older leaves take on a yellow hue until the entire blade becomes yellow-green. This is followed by a tanned or fired effect starting at the tip of the older leaves. The firing or premature yellowing progresses down the leaf in a horizontal pattern.

Merion bluegrass is similar except that there is less of the (reddish) copper hue to the firing.

Phosphorus: The first sign of phosphorus deficiency in Seaside bent and Pennlawn fescue is the appearance of a dark green coloration in the leaves. While the plants tend to be spindly, the shoots are not as short and thin as in plants lacking nitrogen. As the deficiency progresses, the leaves become a dull blue-green in color with purple discolorations appearing along the entire margin of the blade and in the main veins near the base. Gradually these colors give way to dull reddish tints, appearing first near the leaf tips and progressing down the blade. At the climax the entire leaf appears scorched and the leaf tip withered.

Initial symptoms are the same for Merion Kentucky bluegrass. But Merion does not pass through the dull blue-green to purplish stage. The dark green gives way to a tanned condition which appears first at the tip of the older leaves and progresses slowly down the blade. At this stage phosphorus resembles nitrogen deficiency. The difference can be distinguished in several ways. In the case of no nitrogen, the color of the blade below the tanning is very pale green to yellowish-green. In the case of no phosphorus, the color is dark green. Also, the tanning is more intense in the case of no phosphorus.

Potassium: In the early stages of development, potassium deficiency in Seaside bent and Pennlawn fescue is characterized by a drooping appearance of the leaves and a soft feel. Blades are horizontally inclined. The tendency is toward excessive tillering. There is moderate chlorosis (yellowing) in the areas between the veins, particularly in older leaves, followed by rolling and withering of the leaf tips which retain blotches of green coloring. In more advanced stages the chlorotic area extends to the mid-vein which still remains green while the leaf margins become scorched and the tips severely withered.

Symptoms are similar for Merion bluegrass except for the early loss of chlorophyll in the leaf tips and the delayed firing of the tip and marginal scorching of the blades.

Calcium: Symptoms are the same for all three grasses. As noted earlier, the symptoms in young plants are quite different from older ones.

The first signs of calcium deficiency in older plants is the appearance of a reddish-brown discoloration in the tissue between the veins along the margin of the blade in the young (upper) leaves, extending gradually to the mid-vein. Colors fade to lighter shades of red, predominantly rose red. The tips take on a withered or fired condition.

Magnesium: The symptoms are similar for all three grasses and resemble those for calcium. To the casual observer, the deficiencies of calcium and magnesium appear to be identical. In contrast to calcium deficiency symptoms, however, those for magnesium usually appear first in the older (lower) leaves and the initial discoloration is more cherry red. Also, in approximately 30 to 50 per cent of the affected leaves the coloring is blotchy, giving rise to a banded appearance which never occurs in the calcium deficient plants.

Sulfur: Seaside and Pennlawn deficiency symptoms were similar. Like calcium and magnesium, symptoms of sulfur deficiency are late developing and, as a consequence, have only a slight effect on growth.

The initial symptom is the general paling of the leaves. As it progresses, the blades take on a pale yellow-green cast. Accompanying this is the appearance of a faint scorching at the tip of the blade that ad-


SEASIDE BENT GRASS
All Elements
No Nitrogen
No Phosphorus
No Potassium
No Calcium
No Magnesium
No Sulfur
All Elements
MERION BLUE GRASS
All Elements
No Nitrogen
No Phosphorus
No Potassium
No Calcium
No Magnesium
No Sulfur
All Elements
PENNLAWN RED FESCUE
All Elements
No Nitrogen
No Phosphorus
No Potassium
No Calcium
No Magnesium
Each group of unhealthy leaves show progressive stages of deficiency symptoms
All Elements

Photo shows no calcium in the culture solution resulted in no growth in the seedling fescue.

vances toward the leaf base in a thin line along each margin. The border enlarges gradually until finally the entire leaf blade becomes fired and withered.

In Merion bluegrass the shortage of sulfur manifests itself in two ways. As the chlorotic condition develops, the veins, especially the mid-vein, remain green, giving the leaf a striped appearance. Eventually the mid-vein loses its color and the entire blade fires. The other characteristic sign, noted time and again, is the greater susceptibility of these plants to powdery mildew.

Editor's comment about practical application.

An example of magnesium deficiency was observed this spring on a tee in the Montreal district which would have been baffling except for this study. The leaves were exactly like magnesium deficient ones of Merion Kentucky bluegrass. To confirm this diagnosis, a soil sample was collected. It was strongly acid and exceedingly low in magnesium. As a result, dolomitic lime has been used liberally on this and other tees with striking results in overcoming the deficiency.

Another deficiency was noted at Nassau in the Bahamas in St. Augustine grass. This and others that have been observed are being checked out.

The failure of initial root development in the no-calcium nutrient solution has been striking, as noted above. Calcium may play a part in the formation and the stimulation of root growth on new grassland seedings. The marked effect of superphosphate applications on new turfgrass seedings has been stressed frequently. It may be due to the calcium as well as the phosphorus in superphosphate, especially on strongly acid soil, low in available calcium. It is assumed that the other needed elements are in plentiful supply.

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Consultants Suggest Three-Stage Program for Club Expansion

Undoubtedly there are numerous medium size country clubs scattered throughout the U.S. that have reached a crossroad. Whether emphasis should be continued to be placed on golf, probably as was originally intended, or whether it should be expanded to put equal stress on other activities, is a matter that is often debated.

The suggestion that other activities be extended almost invariably calls for expansion of or addition to present facilities. In practically all cases this means renovation of the clubhouse, the possible building of a pool and the addition of such outlying buildings as a pro shop or perhaps a maintenance or general service structure.

When the time comes that club officials or membership committees get down to facts on the expanding of activities of a club, they are faced with questions such as these:

- Is the financial structure of the club adequate to sustain an expansion program and, if so, to what extent?
- What is the reaction of the membership as a whole?
- What effect will expansion (or failure to go through with it) have in 10 or 20 years?

Not Doing The Job

A club in an Eastern city of about 75,000 population recently called in Scudieri and Mankey of Manchester, Conn., architects and sometime club consultants, to survey its facilities and make recommendations for possible future expansion of activities other than golf. Early talks convinced representatives of the consulting firm that many, if not all, of the members were concerned with the fact that the club was not doing the job it should and could do in other than golf activities. It was quite obvious that a family type of operation was wanted, and there was quite strong underlying evidence that the members thought their club was lacking in what they termed "social expression". In reference to the latter, persons who belonged to the club felt that although they had an exceptionally fine golf course there was an overall lack of facilities and activities that engender pride in a club as a whole. The general appearance of the club also was disappointing to some.

The initial survey of the club property which, because there was general satisfaction with the course, was centered on the clubhouse area. The clubhouse was situated in an excellent location, but unfortunately there was little room for future expansion. Recently added parking space had encroached on ground that should have been set aside for adding to the clubhouse. The entrance to the building was from a side from which all the golfing activity emanated, and opposite one of the lockerrooms was the caddy yard, which not only detracted from the overall appearance of the club grounds but through no particular fault of the caddies, was a source of irritation to the members.

The lockerrooms were totally indequate and the pro shop was only about one-third as large as it should have been. For the 300 men and 100 women players there were only 72 lockers in the men's dressing room and less than 20 in the women's. The pro shop with only 600 square feet of space should have contained at least 2,000. Space in the shop for storing bags was practically nil with the result that they were largely kept in a corner of the

men's and women's lockerrooms. As for cart storage space, it literally didn't exist.

More Than Adequate

On the other hand, Scudieri and Mankey, found the restaurant and general clubhouse facilities more than adequate. The dining room, in conjunction with the mixed grill, was probably too large and rarely used to capacity. The kitchen, it was found, was more than adequate from the standpoint of food preparation, but lacking in storage space. The lounge was more of a multi-purpose room and, considering the size of the club, was too large to be used as an informal gathering place.

The clubhouse's front entrance, considering the preoccupation with "social expression", was too drab. It was also decided that because of odd size windows at the rear of the building, the club wasn't taking advantage of a fine view over a nearby waterway. Finally, little use was made of the rear of the building for the construction of terraces and patios.

After making its survey, the consulting firm came to the conclusion that the club in question actually was in good position to expand its social functions because facilities for doing so were quite adequate. It already had a relatively new and large enough swimming pool – probably the first requirement for converting a club to a family-type operation. As a third-stage step in the development of the club, Scudieri and Mankey recommended doubling the area of the ballroom and converting a porch area to a youths' lounge. The latter was to be located in direct proximity to the pool.

Improvements Needed Here

As it turned out, the golf facilities, exclusive of the course, were more in need of overhauling to lend prestige or status to the club than the clubhouse appointments. As a first-stage improvement, the consultants recommended the building of a pro shop in the vicinity of the 10th tee and 18th green. It was to be large enough to increase the sales display area, provide adequate storage space for at least 500 sets of clubs in anticipation of further growth of the membership, and it was to include a small lounge. The consultants estimated the building could be constructed for $15,000.

Second-stage development called for enlarging the lockerrooms and adding 750 square feet of space to the front of the clubhouse to improve the appearance of the entranceway. The women's lockerroom was to be enlarged by combining it with the old pro shop area, while the men's lockerroom was to be expanded by annexing space from the mixed grill. Locker capacity there was to be increased from 72 to 300, while the 20 or so lockers formerly located in the womens dressing room were increased to 100. The estimated cost of enlarging the lockerrooms and refurbishing the front of the building was about $20,000. Decorating of the dining room-grill area and the lounge also was included in this figure.

Total Expense — $50,000

The third-stage improvement, previously described, was to cost approximately $15,000, bringing the total expense of renovating the clubhouse and its environs and bringing them up to the expectations of the membership to $50,000. However, the consultants strongly recommended that the club set up a contingency fund of between $10,000 and $15,000 over the $50,000 to make allowance for any unforseen developments in its improvement program.

The recommendations of the consulting firm were generally favored. The club has indicated that it is ready to go ahead with the first stage of the renovation program. There is, of course, some objection by a small part of the membership to spending from $50,000 to a possible $65,000 in toning up the appearance of the clubhouse and there probably will be some dropouts as a result. In spite of modest initiation fees and relatively low dues, the club is in a A-1 financial position, having no indebtedness whatever. Its operating costs are considered to be very reasonable. The club probably will have no difficulty in obtaining an improvement loan.

Scudieri and Mankey are of the opinion that the club in question in addition to converting to a family-type operation, improving its facilities and appearance and aspiring to a higher level of "social expression' is enhancing its value. The club is located in a metropolitan area and if only routine effort is made in keeping up the property, its value will easily double in 20 years. If it is sold at the end of that time, there is no reason to believe that the club won't realize enough from the sale to finance elsewhere a completely new course, clubhouse and other facilities at little or no cost to the membership. This is an important thing for any club – small, medium or large – to keep sight of when the expense of making improvements is being weighed.

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*Patent Number 2,991,092

AMERICAN CAST IRON PIPE COMPANY
BIRMINGHAM ALABAMA

Speaking of the Greenmasters

Scalzo, Graves Baskin Were 'Up' for Big Tournaments

In the judgment of members and practically all of the players who were the clubs' guests, the three major championships of the year were played on golf courses in perfect condition.

The National Open at Oakmont CC in suburban Pittsburgh, the Masters at the Augusta (Ga.) National GC and the PGA at Aronimink GC, in suburban Philadelphia, represented victories for course supts. as skillfully accomplished (and maybe as lucky) as the triumphs of Jack Nicklaus, Arnold Palmer and Gary Player.

But who, outside of club members and their colleagues in golf course business, knows Lou Scalzo, supt. of Oakmont, John Graves, supt. of Augusta National, and George Baskin, supt. of Aronimink? Probably not even Nicklaus, Palmer and Player ever met any of the three.

The supts. are on the job working while the players are taking bows before cameras and acknowledging the prize money for four rounds of work. The money amounts to a great deal more than any of the supts. get for 365 days and nights of work and ulcers.

The USGA shows appreciation of this situation. At a dinner prior to the Open's first round, USGA Pres. John M. Winters, Jr., referred to the work of Oakmont's supt., Lou Scalzo, and introduced GCSA pres., Sherwood Moore, who presented Scalzo with the supts' association plaque. The USGA says it to the Open course supt. with a cash bonus and cash always speaks reassuring words.

Guards Oakmont Prestige

Scalzo succeeded to the job of the late "Dutch" Loeffler who was regarded by his colleagues as one of the greatest in their ranks. Lou enjoys the same high rating. Oakmont practices haven't been changed much.

Scalzo had the greens cut at 1/8 inch for the Open. The greens (and tees) were fertilized every three weeks with Milorganite. The watering program is not on any fixed schedule. Lou and his experienced staff water whenever they think the greens need watering. The greens are kept on the firm side.

The putting surfaces are rolled with a 75 lb. roller each morning after cutting so the greens will be fast. They certainly are — and as true as a billiard table. Acti-Dione Ferrated is used on the greens once a week, sprayed as a preventive fungicide.

George Baskin helped build the Aronimink course in 1927. Donald Ross was the architect. George stayed with Alec Braca, Aronimink's supt., until 1930. Then he went to Hampton (Va.) GC as supt. In 1934 he returned to Aronimink to manage that course.

Joe Capello, Aronimink's pro, has been there since the club opened. Joe also had worked for Ross at Pinehurst. In Capello and his green chairman, James (Jumbo) Elliott, Baskin has a couple of partners and press agents of the sort to gladden a supt's. heart.

Elliott, internationally famous track coach of Villanova university, heads another fine team in the Baskin-green committee line-up at Aronimink. There are five on the committee. Their handicaps range from 18 to scratch. Elliott maintains that a course and grounds committee should have all classes of golfers represented. A great deal of consideration is given to women's play in the Aronimink committee's planning.

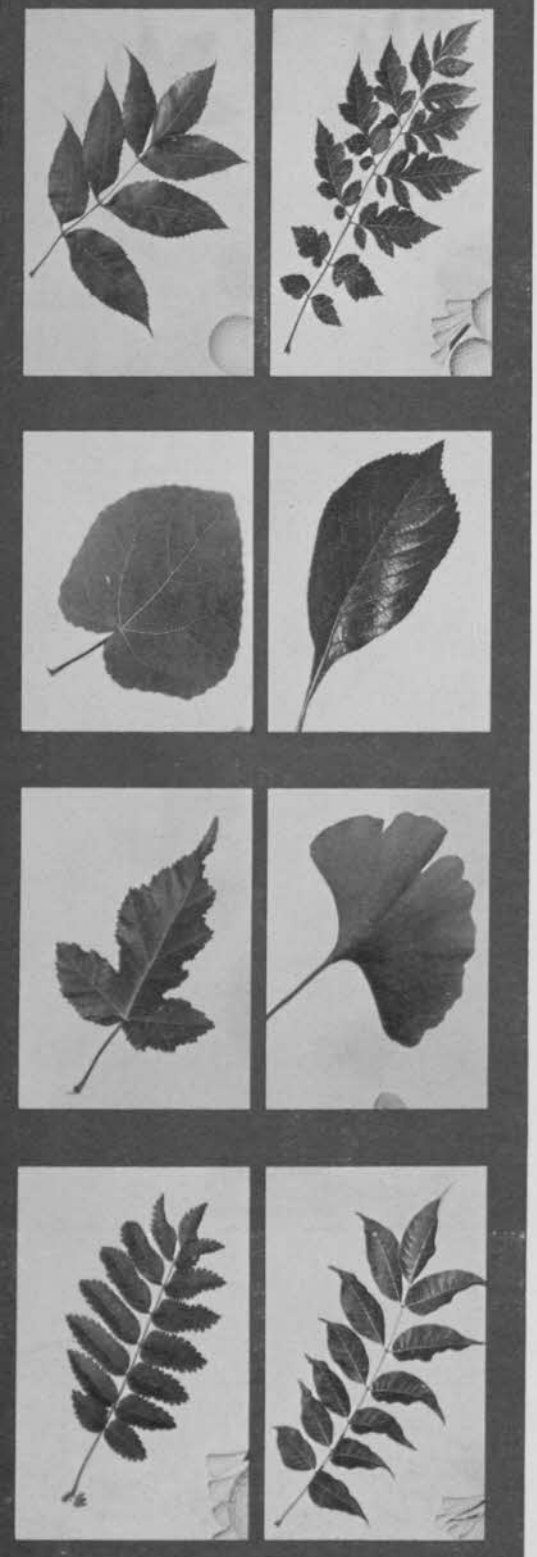
Members Benefited

With the safeguard of a well balanced committee and a smart supt., Aronimink got broad benefits from the approximately $25,000 spent on course alterations in preparation for the PGA championship. In some respects the course was made easier for most of the men

(*Continued on page* 64)

Modernized Label

The USGA executive committee has queried members of the green section staff and committee regarding proposals that the section's name be changed to one more descriptive of its function. There have been suggestions that the green section's name should be as direct and meaningful as names of the Rules of Golf, Implements and Ball, Championship, Handicap and other committees. Course committee is a new title that has been most frequently suggested.



TREES for Your COURSE

Here are 20 varieties that give ample shade and are easy on the maintenance budget

By THEODORE F. APPEL
Cole Nursery Co., Painesville, O.

The selection of trees and shrubs for a golf course can become rather involved. Besides beauty, such factors as soil, drainage, wind exposure, water availability and others have to be taken into account.

A supt., among others, wishes to avoid as much as possible early and heavy leaf drop, large, undesirable fruit, plants that create insect problems and other things that add to maintenance expense and cut down on the time the course is usable. Certainly, no golfer wants to constantly search for a ball that is nestled in a pile of leaves during the fall. Squashy fruits and berries that litter a course also can have an irritating effect.

The ideal tree for a course is one that gives some shade but not enough to prevent vigorous grass growth, has small leaves that disintegrate quickly upon

These leaves identify eight popular species that are ideal for planting on the course. They are (l to r and top to bottom): Marshall seedless ash; Golfenrain; Katsura; Lavelle hawthorne; Amur maple; Maiden-hair; European mountain ash; and Amur Cork.

The Imperial locust is an ideal tree for the course. It is distinguished by its shapeliness, admits filtered sunlight and permits vigorous turf growth.

falling, has no objectionable fruits, transplants easily and is not subject to frost, wind and storm damage. The modern honeylocust comes as close as any to meeting these requirements. Newer selections of this species are ideal. North of the Columbus, Ohio latitude line, for example, this tree is beset by few insect problems. South of this line, the Mimosa webworm occasionally causes only a little trouble.

Of course, no one would want to see a golf course with only one type of tree. It would be most monotonous. So, it is advisable to look into other types. The Ginkgo, or maiden-hair tree, is a desirable one, provided male trees only are used. The female Ginkgo produces unpleasant fruits. (Yes, trees have a sex problem too.) These trees are not as easy to transplant as locusts, but in modest sizes, can be handled bare root.

The Katsura tree is another to be considered in a planting program. It has medium-size leaves that disintegrate quickly, and lovely golden fall coloring. As with the maiden-hair tree, transplanting is not too difficult. It would take too much space to describe the entire list of desirable trees, so we will simply name a few. The figure after the trees indicates estimated height at maturity.

Larger Trees

Sweet Gum, 60; Honeylocust — "Majestic", 60; Honeylocust — "Skyline", 50; Maiden-hair or Ginkgo Tree (Male only), 60; Katsura Tree, 60; Marshall's Seedless Green Ash, 60; Amur Cork Tree (Selected non-fruiting strain), 40; Christine Buisman Elm (Disease resistant), 60; Japanese Keaki Tree (Zelkova), 60; Black Gum (Very hard to transplant), 50.

Medium & Small Trees

Honeylocust — "Imperial", 35; Japanese Pagoda Tree, 35 to 40; Amur Maple, 18; Flowering Dogwood, 20; Lavelle Hawthorne (Tree form), 25; Washington Hawthorne (Tree form), 20; Golden Rain Tree, 25; Flowering Crabapples (Small fruited-tree form), 15 to 25; European Mountain Ash, 30; American Hophornbeam, 35.

Space doesn't permit description of the trees in the foregoing list, but any of the modern tree books describe most of them in detail. All would be acceptable for the average course. None of the lovely American elms is listed here. Unfortunately, the spread of Dutch elm disease and Phloem Necrosis has wiped these trees from the plantsman's list over most of the eastern part of the U. S. and the diseases are moving west.

Sunburst locust or Crimson King maple, both easily distinguishable, make fine marker trees. They can be planted on either or one side of a fairway and at uniform distances from greens and tees. They can be of some help to the average golfer in helping him to get lined up and undoubtedly are appreciated by low-handicap players and pros.

E. P. Hagler, pro and manager of the Duke University Course, is pictured at right with a Cushman Golfster, and above with the Golfster fleet.

CUSHMAN® Gasoline Golfsters® flatten out the hills on the Duke University course

Located at Durham, N.C., the course is famous as the training grounds for many of the nation's best known golfers, including such outstanding pros as Art Wall, Skip Alexander and Mike Souchak. A rolling, forested, 4½ mile long layout, it presents a rugged challenge to the golfer . . . and to any golf cart chosen for the club fleet.

Cushman Gasoline Golfsters have successfully met that challenge, according to E. P. "Dumpy" Hagler, the course pro and manager who has been the Duke varsity golf coach since 1932 and who also served as varsity football line coach from 1931 to 1956.

"We have had excellent service from our Golfsters," said Mr. Hagler. "Personally, I think it is the only type of cart that could be used on this course because of our hills. Incidentally, we are also well satisfied with the two Cushman Trucksters that we use in course maintenance."

UNMATCHED QUIET--UNLIMITED RANGE

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Tie-ins with manufacturers, point-of-purchase promotions and other methods of pushing golf products offer big opportunities for increasing sales . . . but what's being done with them?

The Sad, Neglected State of Pro Shop Advertising

BY AL BONK

I've never heard of a professional who takes adequate advantage of the tax allowance on advertising expense.

Advertising costs are deductible as a business expense for the simple reason that advertising increases sales and consequently the manufacturing, wholesaling and retailing revenue on which taxes are collected.

The golf pro has before him innumerable exhibits of the wisdom and profit of advertising. He sees that, despite the fame of such golfers as Armour, Hagen, Jones, Snead, Palmer, Berg, Suggs and others, manufacturers have to advertise strongly and persistently to establish and maintain a sales value in even the well known names. The names, Kodak and Cadillac, without a build up and the reminders of advertising certainly wouldn't have the powerful appeal to buyers these names now have.

Some Spend Money On It

There are some instances of effective advertising by professionals. George Aulbach in the PGA Business Schools at Clearwater has exhibited letters and circulars that have sold many thousands of dollars worth of shop merchandise, lessons, club cleaning and storage service for him. Harry Obitz, among the older professionals, and Bud Holscher, among the younger ones, are standouts as businessmen who make money by spending money on advertising.

Nobody who knows the whole picture can criticize pro golf merchandising in a broad way. As a matter of cold cash fact, pros generally are superior to many sports goods store retailers in almost every phase of merchandising except advertising.

By advertising, the sporting goods or department stores overcome many of the advantages inherent in the pros' position. The stores budget from four per cent to, on special occasions, as high as eight per cent of expected sales volume for advertising golf equipment.

This would mean at a minimum of four per cent that a professional on a job that has as little as $20,000 a year in revenue, should budget about $800 of this amount for advertising. If a club doesn't provide a pro with any more business than $20,000 it ought to be paying him a good salary. Otherwise, he is paying the club for working for it.

In planning and conducting their advertising to members or to pay-play course players, most professionals can learn a lot from the way in which the stores tie in with club, ball and bag manufacturers' advertising.

Brand Name Helps

It may irritate some pros to see newspaper ads in which prominent manufacturers' names and player names are advertised with cut prices on the merchandise. All there is to this advertising is the name on the merchandise and an obviously cut price, possibly looking even lower than it is because it may refer to a set of two woods and five irons while the pro merchandise usually is in sets of four woods, nine irons and a putter.

In a large amount of the store advertising, the cut price wouldn't mean much if it were not attached to a brand name that is favorably known to golfers.

But dealers also are irritated by the amount of advertising manufacturers do on "pro only" lines. The dealers probably would be even more perturbed if pros would tie in with the manufacturers'