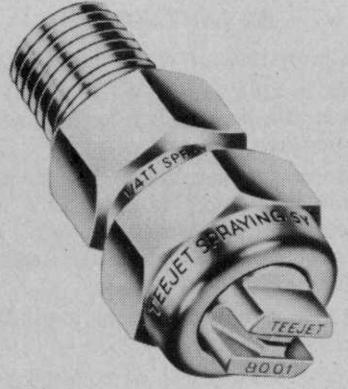


Type ¼ TT Teejet nozzle with flat spray tip.

Type H ¼ U Veejet nozzle.

Type KLC Fieldjet nozzle.

mold temperature, mold pressure, molding time, the plastic used, the plastic temperature, the skill of the operator or the skill of the set-up man. Accuracy is not one of the strong points of this type of orifice in a production run due to the aforementioned variables. Machining plastic would improve the accuracy, but results in fibers and burrs in the orifice that would require hand deburring at a great expense and possible distortion of the spray.

BRASS AND ALUMINUM are easily machined, can be made to almost any tolerance desired if the proper equipment is available, will withstand most of the ordinary agricultural chemicals used in weed and pest control, and are readily available. Aluminum does have the tendency to gall and to wire draw if hurried through the machining process. If threaded and joined aluminum to aluminum, then a lubricant, such as molybdenum disulphide is suggested so that the parts ring with the spray pattern, but may be disassembled at a future time.

STAINLESS STEEL orifices are punched, drilled or machined, depending upon the type being produced. If punched, then one must expect dulled or broken punches which will produce irregular or oversized orifices, resulting in greater capacities than those indicated on the nozzle. In addition, ridges and burrs can be found within the orifice as well as on either side of it that will interfere with the flow characteristics of the liquid and the nozzle capacity. If machined to tolerances, then the only care to be taken concerns the fibrous nature of stainless steel itself. Minute burrs or fibers can be pulled into the orifice by the dragging action caused by the drill, or cutter in forming the orifice. This occurs when the machine is pushed for time on each tip and cannot properly do the work it should, or the tools are too dull.

HARDENED STAINLESS STEEL has the same problems as stainless steel, but a much tougher grade of stainless is used and it has a tendency to chip or break off pieces as it is machined. Furthermore, the stainless qualities can be lost or greatly reduced if the heat-treating process that hardens it is done incorrectly.

CERAMIC orifices are sensitive to chipping or crumbling when made, which will result in distorted spray patterns and flow rates due to the orifice irregularities. Among new orifices, whether molded or machined, a wide variation of flow rates is found among those orifices supposed to be of the same size. The normal orifice configuration requires an extreme control of dimensions and positions that ceramic fabrication methods cannot meet. Experimental tests with ceramics, as with plastics, have resulted in great variations in the orifices of a single batch, and even wider variations in batch to batch runs. Orifices can be individually tested, selected and matched, but that would defeat the low cost supposedly possible through their use. Ceramic technology is certainly well advanced for many items, but it has not gone far enough nor adequately enough for spray nozzle orifices.

TUNGSTEN CARBIDE orifices can be manufactured with great accuracy. The corrosion resistance to various chemicals is an unknown, and even greater variation can be expected when these chemicals are mixed with local water supplies. However, one could expect a long life from these orifices due to erosive conditions that might be present, such as high pressure or entrained solids or both. Orifices of tungsten carbide are quite expensive when compared to brass or stainless steel, but if there is no violent corrosive condition present, and the erosive condition is not excessive, then one could expect the orifice to outlast the machine and still be accurate.

So far precision has been mentioned and alluded to without any figures to back it up. One way to approaching the problem in through your pocketbook. If you were spraying a chemical that costs $3.20 per gallon, and you were to mix it at a rate of 1 pint per 5 gallons of water, and apply it at a rate of 5 gallons per acre, then 1 gallon of the chemical could treat 8 acres at a chemical cost of 40 cents per acre, or $40.00 per hundred acres.

Some of the more unusual weed control applications in the central portion of the country have been:

Airplane or helicopter spraying under strict control conditions to prevent leakage and spray drift. An interesting application has been to control brush, followed by basal spot spraying from horseback to complete the kill.

Additional aerial spraying has been for brush control along power lines, pipe lines, railroad tracks, streams, etc. These are often followed in a few weeks by further application from ground driven equipment and handguns to complete the control program.

Railroad rights-of-way spraying is done either by the railroads themselves, or by contracting firms. The aim is bare ground on the ballast so that resiliency will be maintained. Decaying vegetation retains water and thus fosters compaction of the ballast. Large volumes of liquid are sprayed by tank trains moving at fairly rapid speeds. The desire is to have large drops and no drift, with complete coverage of the ballast.

Another area where complete vegetative control is desired is around, and upon, ammunition storage bunkers in the various arsenals. This is so that a grass fire will not set off the explosives. Standard weed control nozzles are used here, plus handguns to reach places where equipment is unable to enter.

We have varied an orifice for spot treatment of Johnson- or Bermudagrass clumps from a knapsack sprayer that uses gravity flow of the liquid. Our TK FloodJet tip could also be used with one of our trigger type of handguns.

There are several sectors of agriculture that can use a broadcast method of weed control. We could expect ground equipment to use the BoomJet, FloodJet, or FieldJet nozzle for these purposes along power lines, for brush control, in pasturelands, roadsides, drainage ditches, streams, ponds and other waterways to clear out choking vegetation such as water hyacinths. The process is also used to break up oil spills in Sweden and in the Gulf of Mexico.

Another use to to combine herbicides and/or insecticides with fertilizer in solution or suspension, and to broadcast apply it on fields. However, there is a problem here, a plant root will travel to a food source, whereas a given amount of herbicide must be deposited upon a plant to kill it. Therefore, one must not expect complete weed control from broadcast applications since the drops will vary in size and distribution due to pressure variations, viscosity of the liquid, speed across the field, height and attitude of nozzle in relation to the ground surface, plus any of many variables that always seem to arise at unexpected moments.

Lastly, there is the possibility of using Ultra Low Volume sprays to directly apply technical grade herbicides. The U.S.D.A. defines them as:

1. Ultra-Ultra Low Volume ....to 8 oz. per acre.
2. Ultra Low Volume ....8 oz. through 64 oz. per acre.
3. Low Volume ....65 oz. per acre to complete coverage.
4. Conventional ....to run off.

It had been proposed in 1967 that conventional be considered as all applications above 4 gallons per acre, and that low volume be from 65 oz. per acre to 4 gallons per acre.

All of you are aware of the 5 gallons per acre, and larger capacity, nozzles for weed control. We have also produced orifices that can apply less than 1 gallon per acre, but run into a series of conditions of which you might be unaware. First of all, your equipment must be scrupulously clean to continue to operate; second, pressures will have to be increased for the very small capacities in order to form the spray, and that means greater speed of the spray rig to hold down the gallonage per acre; and last, you cannot **see** whether the nozzle is operating or not, and this is the most critical of all the points. That which is left is a mist-type of unit using a large fan to shear and distribute the chemical over the crop area, and the obvious problems that entails when using herbicides, or the helicopter/airplane for aerial application, and this is where the spraying of technical grade chemicals originated on a large scale. Lastly, there is a method of using compressed air to atomize, impact and project technical grade chemicals onto a crop at a rate as low as 4 oz. per acre. However, 16 oz. to 32 oz. appears to be a more parctical rate to use. Fluid rates can vary with the pressure applied, degree of atomization will vary with air pressure from 7 psi to 15 psi. Experience has shown 7 - 9 psi of air is sufficient.

ADVANTAGES

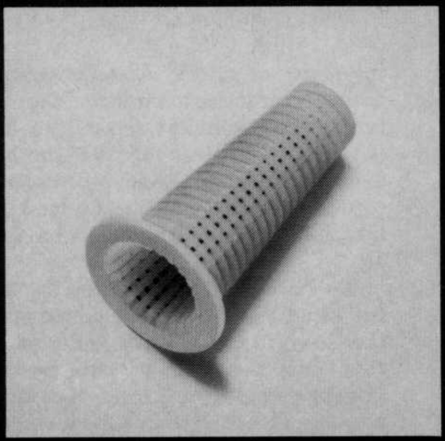
1. Elimination of water hauling.
2. No mixing required—chemical is sprayed as supplied by the manufacturer.
3. More effective use of the chemical—tests indicate that ULV insecticide applications can be made on an extended spray schedule.
4. Reliable equipment is available in some areas.
5. More acreage can be covered per day.
6. More latitude is available to the chemical formulator.

DISADVANTAGES

1. Air assisted atomization creates such fine particles that wind drift will be a definite hazard.
2. Conventional equipment cannot be used. New, and more expensive controls, instruments, air compressors, pumps, etc. and other parts must be obtained to supply the accuracy needed.
3. Operators must be trained.
4. Because it is an herbicide that we are considering, absolute precission is necessary throughout the equipment and application procedures.
5. Internal cleanliness of equipment is a must.
6. If used for herbicides, the equipment cannot be used to apply insecticides or fungicides to herbicide susceptible crops. This is quite an expense to stand idle.

We are now engaged in a study of particle sizes produced by various orifices under varying conditions. So far none of this information has been published, and it may never be for its use is highly specialized. We will listen to the needs of scientists, and can often give them the information desired in short order. However, we cannot do research work for firms if it has no bearing on our needs.

Why we spent $25,000 to develop a 10¢ grit screen.



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Effects of Weed Control on the Environment

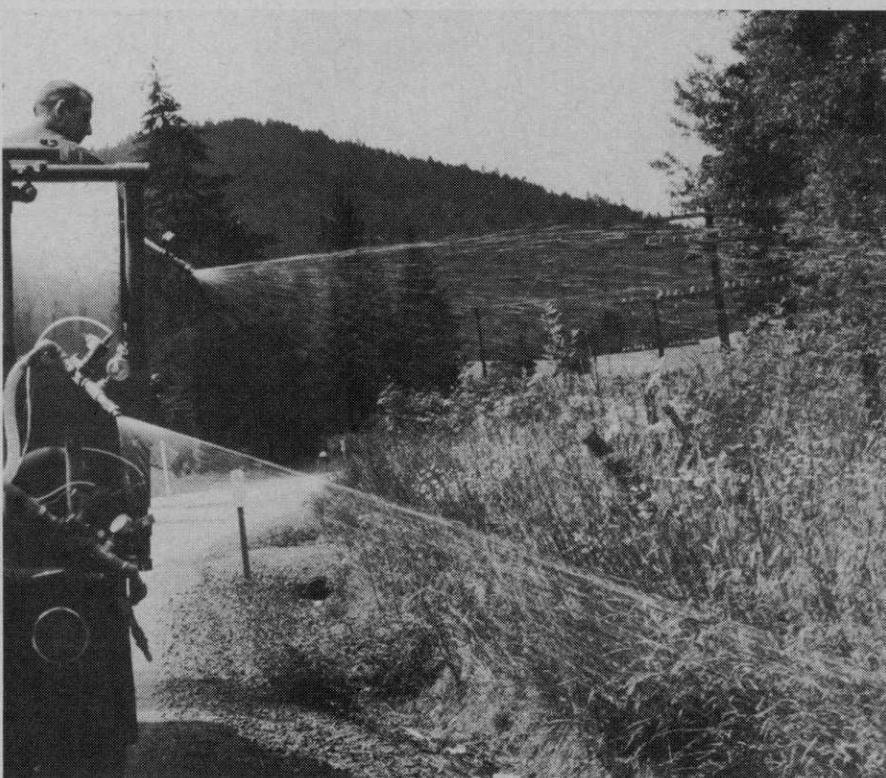
By W. A. HARVEY
Extension Environmentalist
University of California, Davis

THE only reason for any weed control practice is to change the environment:

- to permit the production of food and fiber in quantities sufficient to feed and clothe our growing population.
- to provide beauty and recreation —attractive lawns, gardens, landscapes, camping sites, fishing, swimming and other outdoor sports.
- to insure safety from fire, from effects of traffic obstructions and from allergy sources — poison oak, ragweed, etc.

Control of vegetation is essential joyment of life. And vegetation control practices change the botanical environment around us. This is true regardless of the methods used for control—hand pulling, hoe- to our health, well being and en- ing, plowing, cultivating, burning, etc.

We know, then, that any successful weed control practice must affect the environment. We should expect this. Our concern is with possible effects outside the target area or on non-target organisms. Our principal concern is with herbicides, although we can get side effects with other control methods—soil erosion, soil compaction, air contamination with dust or smoke, etc.



We know that certain chlorinated hydrocarbon insecticides have come under heavy criticism. Organic herbicides have had relatively little criticism because most of them are low in mammalian toxicity and have short persistence in the environment under most conditions. The major challenge has been the 2,4,5-T uproar.

Let's review, briefly, what we know about environmental contamination by herbicides under four headings: entry, persistence, residues, effects on organisms.

ENTRY: Herbicides, to be effective, must become an intimate part of the environment of the target plants. It is only when they move away from the target site or persist sufficiently to affect later plantings that they become a problem. Herbicides can move by drift of particles at and soon after the time of application, by volatility from a treated area, by leaching, and by surface movement through wind or water erosion.

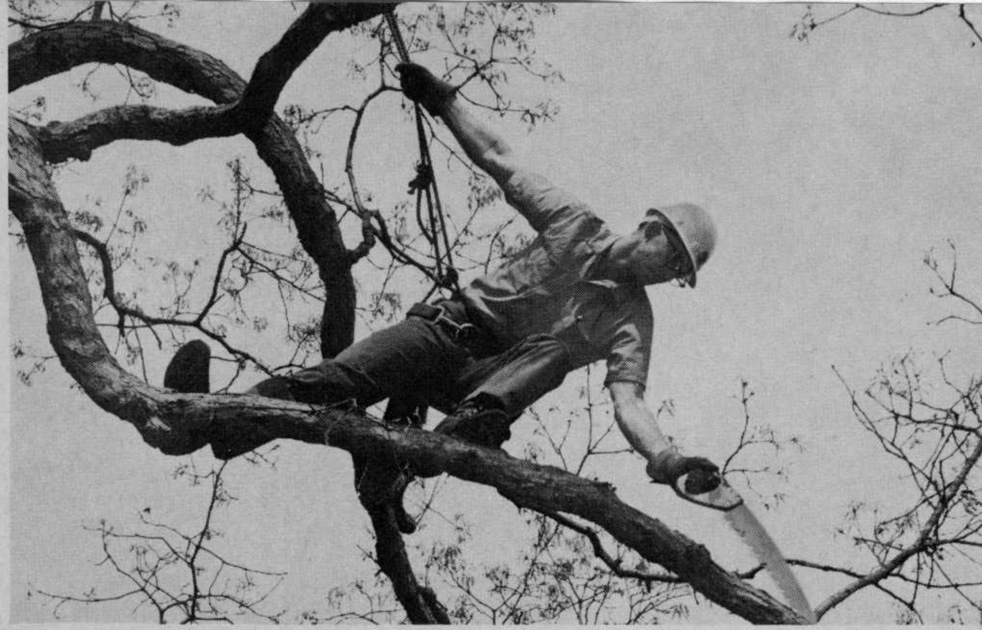
Drift. Small particles produced as the spray solution leaves the nozzle may remain suspended in the air for varying periods of time depending primarily on droplet size. The distance these particles will travel depends primarily on wind velocity. In any spray operation a certain fraction of the liquid will be in small particles or droplets and some drift is inevitable. The effect of this drift depends on the herbicide involved and the proximity of sensitive plants.

Volatility. Volatility results from movement of materials in a vapor phase from the treated area to other areas by wind or air mass movement.

Leaching. Leaching is movement of a chemical down into the soil profile with water movement. Our concern in terms of environmental contamination is not with movement in the soil itself but with vertical movement as a potential source of contamination of ground water supplies.

The amount of herbicide at different levels in the soil depends upon several factors. The soil type—sand, silt, clay, muck, etc. determines the depth of water movement in soil and consequently the depth to which any given herbicide will move. In addition the soil type has an effect through its properties for adsorption and holding molecules of the herbicide against leaching forces.

(Continued on page 16)



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WEED CONTROL *(from page 14)*

The amount of water entering the soil either from rainfall or irrigation and the solubility of the herbicide in water are also important factors.

The final factor that affects leaching is the degradability of the herbicide itself from either chemical reactions or biological agents. The more rapidly a herbicide is broken down, the less time there is for leaching.

Because of the number of factors limiting leaching we have so far found no evidence of ground water contamination from field use of herbicides.

Surface Movement. A final method by which herbicides might move into the environment is through surface movement by wind or water, usually with soil particles. In field experience, water has been the major element in causing such surface movement. Factors affecting such movement include: slope or steepness of the area which affects run-off, permeability of the soil, amount and intensity of the precepitation, formulation of the herbicide (principally solubility), rate of application, and vegetative cover.

PERSISTENCE: Herbicides, particularly soil-applied herbicides, must persist in the environment for a long enough time to provide some period of weed control. Here we are faced with something of a dilemma.

In crop land we would like weed control during the growing period of the crop. But once the crop is harvested we may want to plant a different crop and perhaps one that is susceptible to the herbicide used in the first crop. So we don't want to jeopardize future crops with herbicide residues and yet we would like weed control throughout the growing period of any treated crop. We often must settle for a period of weed control during the germination and early growth of a crop and depend upon crop competition, cultivation, or repeated herbicide treatments to give season-long control. On non-crop sites we usually want at least one season of weed control per treatment.

Soil persistence is usually our major concern, and it is difficult to set exact values on the length of time any herbicide will remain in the soil. We know that herbicides such as the carbamates give weed control for something like six weeks whereas some of the triazines and the substituted ureas may persist for six months or more when used at crop selective rates. Soil persistence depends on several factors: rate and formulation of herbicide, soil type, temperature, moisture, organic matter, and microbial activity.

In general, soil breakdown is most rapid in warm, moist soils with good microbial growth. With some highly water soluble herbicides, leaching below the root zone may cause a rapid loss of immediate toxicity without actual breakdown. Cold soils, dry soils and sterile soils usually inhibit breakdown and prolong persistence.

Peristence in water is of concern for those herbicides used for aquatic weed control either when applied into the water itself as for submerged aquatics or when applied for emerged or ditchbank weeds when some portion of the treatment may get into canals or ditches.

There is less information on water persistence of herbicides than on soil persistence, but the literature in this area is increasing. It appears that breakdown in water is mostly microbial with definite evidence of removal from water by precipitation and by absorption on particulate matter. There is likewise evidence of peristence in bottom mud where anaerobic conditions may reduce activity of the particular microbes responsible for decomposition.

Recent studies show only minute amounts of herbicides appearing in irrigation water from ditchbank spray operations. It would appear that careful ditchbank application of current herbicides present no appreciable hazard to downstream vegetation or crop irrigations. Treatments to the water itself have caused no reported crop loss when used as directed. Most truly aquatic herbicides do affect other aquatic organisms, however, and their use is usually confined to irrigation canals where game fish are not resident.

Persistence of herbicides in air has not been widely studied. A study in Washington State over a period of 106 days during and following the wheat spraying season revealed minute quantities of 2,4-D in 80% of the air samples. Dilution by air mass and wash out by rainfall probably account for the disappearance of the limited amount of herbicides that get into the air, although

(Continued on page 40)

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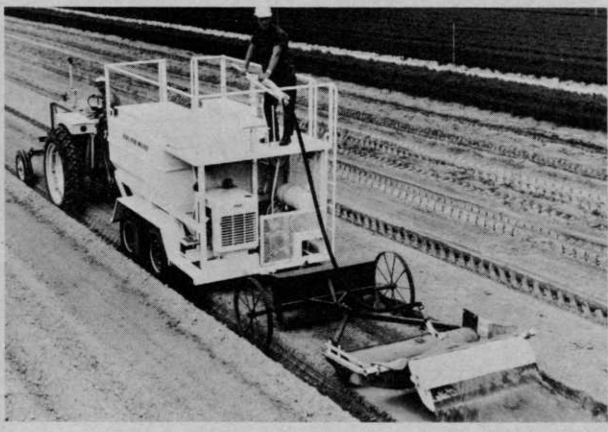

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The Hotel course is the "palm tree" course while the Boca Raton West courses are sprinkled with pines. The palms are an extra maintenance headache, and must be trimmed regularly.

Grass flies at Boca West. Year-around operation puts a strain on machines and maintenance scheduling. A partial equipment list for the four courses includes triplex greens mowers and walking greens mowers plus a complete line.

Green Industry *(from page 8)*

Arvida is a builder, a developer, and a salesman of resorts, hotels, and entire residential complexes of all kinds. It is one of Florida's largest landholders with practically all of its 34,000 acres situated in three southeastern "Gold Coast" counties. Arvida's holdings include the world-famous Boca Raton Hotel and Club, whose recorded history is more fascinating than its considerable legendary trappings.

Harry Eckhoff, facility development consultant of the National Golf Foundation, says Arvida is representative of planners and developers of modern communities who "consider golf courses one of their most effective sales weapons."

NGF records reveal, says Eckhoff, "that more than 25% of all new golf facilities opened for play in 1969 were part of golf and real estate ventures, such as high-rise apartments and condominiums, housing developments, mobile home sites and vacation or second-home projects.

Having extensive property to maintain is one thing; with golf courses included, the problem can become complicated.

Arvida has a golf course professional on its top management staff to head off maintenance problems and costs through proper development.

C. C. Shaw, who counts 40 years' experience in every aspect of golfing, knows the industry from the blueprint to the pop-up sprinkler. In essence, his job is to expertly mesh together the ideas of the architect, the requirements of a golf course, existing land available, the housing concept, and the investor's hopes for a good return on their money.

From a land developer's viewpoint, Shaw said, "a golf course is a necessary cost item." Land taken up by a golf course would return more money if it were in housing or hotel units, he explained "but people want to play golf. Some play the game from sunup to sundown. And they don't want to travel far to play, especially those who have retired."

Aside from the inclusion of golf courses in its residential and resort complexes, Arvida planners design extensive greenbelt areas.

The critical coordinating that Shaw must do doesn't end when the earthmovers take their first bite. Practically never is the blueprint totally transferable to the actual site. The project can be likened to a puzzle. Change the shape of one piece and you affect the shape of dozens of others. Because a golf course represents a major segment of any development, any change at all will usually affect it. That's where Shaw comes in. A mistake can mean a continuing, costly maintenance problem.

A centralized maintenance system was tried, said Shaw, but it didn't work. So the system that has evolved is a landscape maintenance professional at each Arvida property. This individual works independently of his counterparts (although the superintendents of the golf courses in Boca Raton closely coordinate their activities). Maintenance budgets are a part of the respective facilities' operations.

"I'm not certain if there is such a thing as an exact budget for golf course maintenance," said Mac Parsons, superintendent of an 18-hole course and a 9-hole executive course adjacent to the Boca Raton Hotel. "We request what we think we need and usually get it. For example, we can buy sod cheaper than we can maintain it. When we go in for maintenance funds, things like this are taken into consideration."

Shaw estimated the maintenance cost for a golf course that is open year around to be "in the neighborhood of $100,000 for 18 holes."

Across town is a total community development, Boca Raton West, that will eventually encompass 1,400 acres. Plans call for four 18-hole championship courses. Two of these courses are now completed and in operation. Course superintendent is W. H. Wright.

"We try to buy all the materials we can through the University Park Nursery in Boca Raton. This is another division of Arvida," said Wright. "However, if we get a better price somewhere else, we go there."

Elevation in the Boca Raton area is about 12 feet of sand above sea level, and that means the courses experience severe leaching of fertilizers and chemicals. "We'll use five to six times the amount of organics used in the north," said Parsons.

Water supply is critical. Three deep wells at the hotel and six at Boca West are the sources. Shallow wells are contaminated with limestone and rust. Percolation and evaporation rates are high priority conditions to watch. "We may use two million gallons a day in the dry season," said Parsons.

"When the temperature reaches 80 degrees," Wright added, we can lose .3 inch of water per day."

Design of Boca West, a 1,400 acre spread of which the two operating golf courses take in 400 acres, includes numerous water holding areas. They are all connected to a pumping station located at the edge of the Hillsboro Canal, which empties into the ocean. Since too much water can be as much of a problem as too little, a large turbine pump is used to remove excess water. "We can literally reduce the water table from under the entire development," said Wright. "We have pumped 13 million gallons in a 24-hour period."

The chemical bill at Boca West runs about $15,000; the Hotel's about $7,800. About 50% goes for insecticides, 25% each for herbicides and fungicides.

Overseeding of Penncross bentgrass and Pennlawn fescue runs about $7,800 a year. The fertilizer tab is about $28,000.

Arvida Corporation, in adding new dimension to the tradition of Boca Raton, is openly sinking a fortune into the area and publicizing it lavishly. The customer has the option of enjoying the grandeur of the Hotel and Club, or purchasing a piece of the grandeur of an Arvida development and living there year around.

Match Tree Selection To Use Area

By WILLIAM H. COLLINS

Horticulturist
Cole Nursery Company, Inc.
Circleville, Ohio

Sovereign Pin Oak, a new, improved variety. Growth is vigorous and branching is upright and well-spaced.

THE environment around us is changing. There are changes in the soil in which we place plants—and changes in the air in which we expect them to grow.

Most kinds of plants growing in their native environment may not only be in competition with each other but also with dozens or hundreds of other kinds, each seeking to capture their share of space in the soil and in the air.

When man takes a seedling from the woods or grows one, he usually plants it in a man-altered location. Formerly such plants grew into what we call "specimen plants;" that is, naturally shaped plants, the result of little or no competition. Such plants grew more vigorously than their counterparts in a native environment. However, each year we see more clearly that the formerly favored plant is now growing in a more difficult situation than ever existed in its original native environment.

How have these changes come about?

First, we have blended, covered or removed the so-called original top soil, the result of thousands of years of preparation and a medium of relatively delicate balance. We have created either vast open space areas, or built narrow street channels between long rows of buildings where gusty winds, radiating heat and uneven rainfall patterns are not duplicated anywhere in the natural plant world.

We emit into the atmosphere quantities and kinds of gases and particles that were not formerly present. We add salts and other chemicals to roads and sidewalks, some of which may even damage foliage and trunks before they become incorporated in the soil and damage roots.

How can we find ways or plants that will grow acceptably in this environment? . . . an environment which more than ever needs growing plants!

We know we can usually provide better root growing conditions at the planting site and we can improve maintenance and care, but until we slow down or reverse pollution, one answer is to find or create more tolerant plants.

We can select and perhaps breed new trees, shrubs, evergreens and grasses that are more able to resist these man-made conditions. This means a re-evaluation, a fresh unbiased look at many woody plants that up to now may have been considered not good enough ornamentally.