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DR. RAY A. KEEN
Professor of Horticulture
Kansas State University



Dr. Ray A. Keen, a native Kansan, attended rural and Topeka schools and worked on the farm and in nurseries. After graduation in 1934, he spent 1 year in the C.C.C. in Minnesota in the Itasca National Forest in surveying and fire control. He worked as a grower for Rosemary's Flowers and as a cabinetmaker until 1938, when he entered Kansas State College. Graduation in 1942, with a major in Landscape Horticulture, was followed by 4 years in the Navy as a Lieutenant. He wrote his M.S. thesis at The Ohio State University on "A Study of the Genus Taxus" in 1947.

Dr. Keen returned to Kansas State in June 1947 as the first Ornamental Horticulturist, teaching courses in Plant Materials, Arboriculture, and Nursery Management. He also served as Secretary-Treasurer of the Kansas State Florists Association, 1949-52, and the Kansas Association of Nurserymen for several years.

During a Sabbatical Leave, 1953-54, he completed residence on the Ph.D. at Ohio State. His dissertation, a monograph of the Yews of North America, was completed in 1955. His Taxus Herbarium exceeds 550 sheets.

Dr. Keen has been responsible for research in fine turfgrasses at K.S.U. since 1950, and added the first course in 1955. Since then, additional faculty and support has resulted in nearly full time in the area of Turfgrass Management. He shares teaching responsibility for 150 Ornamental Horticulture students with four other faculty. Present classes include Arboriculture, Turfgrass Management, Turfgrass Science, and Plants, Man and Environment. He has been active in several honor and professional societies and the K.S.U. Faculty Senate.

He initiated the Kansas State Shade Tree Conference and was a founder and Charter Member of the Kansas Arborists Association. Dr. Keen has served as Secretary-Treasurer of the Central Plains Turfgrass Foundation since 1956. Publications have been in Turfgrass Science, Plant Propagation and Taxus.

Dr. Keen has served on the Graduate Faculty since 1948 and has many alumni in the U. S. and abroad.

HISTORY AND DEVELOPMENT OF TAXUS IN THE U.S.

Dr. Ray A. Keen
Professor of Horticulture
Kansas State University

The beginning of the Taxads lies buried, with the early history of all seed plants, somewhere below the Jurassic age shales and sandstones which rim the North Sea (Florin, 1958). Among the abundant taxad fossils along the Yorkshire coast, branches of *Taxus*, complete with seeds, have been found which differed from *Taxus baccata* L. only in minor details of epidermal cells associated with the guard cells. 150 million years ago the continents were well bunched and this helps explain the circum temperate zone distribution of the genus. The rather limited but widely scattered distribution of the genus today would indicate the plant geographer could gain much by study of this pattern.

Throughout Europe, *Taxus baccata* is found on sweet soils with cool climates. It is also reported from the mountains of North Africa and the Near East. With a name change, the geographical species *T. Wallichiana* is found through the Himalayans to the mountains of the Phillippines. *T. cuspidata* S. & Z. occurs in East China, Korea, and the mountains of Japan, with *T. chinensis* Rehd. and possibly other species occurring in the Chinese interior.

In North America, *T. canadensis* Marsh. occurs as an understory throughout the Great Lakes Boreal Forest and in relict communities as far south as Virginia, Kentucky, and Indiana. In cultivation are two clones slightly more dense and erect to ascending.

The status of *T. floridana* Chap. as a relict of the Ice Ages or even earlier remains moot. It is confined to the sweet soils along a short section of the east bank of the Apalachicola River in the Northwest Panhandle. Torreya State Park is the best place to view it today in Florida.

In the mountains of Mexico, *Taxus globosa* Schlect. is found as an understory plant in Beech-Maple forests similar to those of Ohio and Pennsylvania. There is no record of its cultivation.

In the mountains of Idaho, *T. brevifolia* Nutt. is a shrubby understory plant little larger than *T. canadensis*, but easily qualifies as a small excurrent tree in eastern Washington and in the mountains of California. In the Puget Sound area, it is a tree to 80 feet but still understory to the giant conifers of that region.

The introduction of *T. baccata* into America is more a matter of inference than written record. The first settlers brought an endless list of cultivated plants from Europe and trade in plants from Virginia was brisk in England, France, and the Netherlands. Bartram and others received as well as exported plants.

The largest and oldest trees of *T. baccata* are found around old cemeteries (Mix, 1949), old plantations of the South, and old estates on either side of Long Island Sound. Many of these were moved during the 1930's. Some were moved to the Lincoln Memorial (Jefferson, 1975) and Longwood Gardens, Kennett Square, Pa., by the firm of Lewis and Valentine. Records are very incomplete on these operations. Fine specimens still exist on Long Island and at 20 Kay street,

Providence, R. I. At White Marsh Plantation in the Tidewater area of Virginia are a number of large cultivars dating from the 1850's. These survive because they're planted in deep beds of oyster shells on the site of an ancient Indian village. A fine group of trees stands in the Bishop's Garden, National Cathedral, Washington, D. C.

Nurseries were responsible for the introduction of most of the cultivars of English Yew (Hoopes, 1868) but Rochester, N.Y., Parks and Arnold Arboretum introduced some. It would appear that *T. b.* 'Repandens' is the only clone developed in America. Hardier material from the mountains of Eastern Europe has been introduced by Missouri Botanical Gardens.

Taxus chinensis Rehder was grown at the Arnold Arboretum from seed collected in the interior of China by Wilson (Sargent, 1914). It is seldom in the trade, but large female plants are at the Arnold Arboretum, the old *Taxus* section at Secret Arboretum, and the Hunnewell Estate in Wellesley, Mass. A large male plant is in the Morris Arboretum in Philadelphia, Pa. The seed on the isolated female plants should produce hybrids if planted.

Taxus cuspidata Seib. & Zucc. was first brought to the U.S. from Japan in 1862 by Geo. R. Hall, M.D., who released it to the trade through Parsons and Co., Flushing, N. Y., according to Wilson (1916). Direct importation of seed and several clones, 'Nana', 'Densa', and 'Aurescens', soon followed. Their slow growth and high cost did little to popularize the yews, even though the added hardiness of *T. cuspidata* greatly extended the range into the most populous part of the nation. Parsons & Co. selected a vigorous cultivar 'Robusta' which appears to have hybrid vigor. The cultivars 'Thayer', 'Adams', 'Prostrate', 'Minima', and 'Intermedia' were early selections.

Taxus x hunnewelliana Rehder was recognized as a chance hybrid grown from seed of *T. canadensis* on the Hunnewell Estate at Wellesley, Mass., by T. D. Hatfield about 1900 (Rehder, 1925). At first considered an excurrent *T. canadensis*, this yew has remained in the trade because of its hardiness, good color, and fine texture. A hedge of F₁ seedlings at Wellesley is remarkably uniform. Back crosses and other combinations should be expected to crop up from time to time.

Taxus x media was the name selected by Rehder (1923) for the hybrids of *T. baccata* x *cuspidata*, recognizing the broad spectrum of cultivars possible between the several clones of each species then in cultivation. The hybrid vigor, ease of propagation, and increased hardiness of these hybrids had done much to increase the popularity of Yews as landscape material in America. The Hatfield hybrids came as a result of a decision of Mr. Hunnewell to discontinue giving winter greenhouse space to a tubbed specimen of *T. baccata* 'Fastigiata' sheared as a cross. Mr. Hatfield gathered seed from this plant which could have been pollinated only by male *T. cuspidata* nearby. It was several years before the hybrid nature of these plants was recognized. At least 11 cultivars were named from the initial planting, including 'Hatfieldii', 'Brownii', 'Sewelii', 'Wardi', 'Wellesleyana', 'Wymani', and 'Runyan'. Several synonyms and some selected from "Yew hybrids" propagated in the Netherlands also trace to this material (Keen, 1956).

The reciprocal cross was being propagated at about the same time by the Hicks Nursery on Long Island. Seed was collected on the William Dana estate from *T. cuspidata* 'Nana', with *T. baccata* 'Glauca' the most probable pollen source, both from its proximity and the dark bluegreen color and erect habit

of the seedlings, of which 'Hicksii' and 'Costich' remain in the trade.

Thousands of seedlings from various mixed plantings have since been grown. From these an endless parade of cultivars has been selected, many of short duration in the trade. Nurserymen desire a very fast growing, free-branching form which propagates easily and makes a salable plant with a minimum of time and effort. This trend follows through the various "Improved Intermedias" to the currently popular 'Densiformis'. One of the great values of the Taxus Plantation in the Secrest Arboretum, Wooster, Ohio, has been to show the true size and habit of these plants.

The program that produced these plants is a part of the great effort which has provided suburban housing with landscaping for half of the U.S. population in 30 years. With the turn to better gardeners and interest in quality, it is time to start promoting quality and "aristocracy" in the dwarf and slower growing clones which improve in value and size on the collector's premises. One need not be a Gotelli to have *all* of the dwarf *Taxus* in the world growing in his collection. A check at the National Arboretum revealed only six *Taxus* presently in that collection.

Interest in the colored foliage Yews is probably at an all-time low. From the chartreuse green of 'Green Mountain' to the near black of 'Nigra', most commercial yews are green. A small seedbed of seedlings grown by Frank Turner from several golden yew sources resulted in hundreds of various shades of golden "Mongrels" at the Berryhill Nursery. Some of these were dwarf, dense, compact, excellent clones if there had been a demand for them. An excellent blue form was observed as a seedling *T. cuspidata* selected by Mr. Baker at the Hiti Nursery, Pomfret, Conn. He had propagated a few "spreaders" from lateral twigs.

Weeping forms of *T. baccata* -- 'Gracilis' and 'Pendula' -- are known in arboretums, but they are quite tender. A very hardy weeping *T. cuspidata* exists as Seedling #74 in a planting made by Mr. B. Slavin in Durand Eastman Park, Rochester, N. Y.

The collection of fastigiata clones sent to Secrest Arboretum by the Vermeulen Nursery gives an idea of the possibilities with this form and demonstrates that the potential of the genus *Taxus* as a source of landscape forms has barely begun.

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DR. LEWIS CHARLES CHADWICK
Professor Emeritus of Horticulture
The Ohio State University
Ohio Agricultural Research and Development Center

Education:

B.S., University of Vermont, 1925
Ph.D., Cornell University, 1931

Academic Experience:

Instructor in Ornamental Horticulture, Cornell University, 1925-29
Assistant Professor of Horticulture, The Ohio State University, 1929-37
Associate Professor of Horticulture, The Ohio State University and Ohio Agricultural Research and Development Center, 1937-47
Professor of Horticulture, The Ohio State University and Ohio Agricultural Research and Development Center, 1947-67
Professor Emeritus, The Ohio State University and Ohio Agricultural Research and Development Center, 1967

Member of Societies:

American Association of Botanical Gardens and Arboretums
American Rose Society
American Society of Consulting Arborists (President, 1972)
Columbus Landscape Association (President, 1932-34)
International Shade Tree Conference (Editor, 1936-37; Secretary-Treasurer, 1937-63; Executive Director, 1963-69; Executive Director Emeritus, 1969; Honorary Life Member, 1969)
International Plant Propagators Society (President, 1953-54; Life Member, 1957)
National Arborist Association (Honorary Life Member)
National Landscape Nurserymen's Association (Honorary Member)
Ohio Chapter, International Shade Tree Conference (Secretary-Treasurer, 1942-73; Executive Secretary, 1974)
Ohio Nurserymen's Association (Honorary Member)
The American Association of Emeriti
The American Association of University Professors
The American Horticultural Society
The American Institute of Biological Sciences

The American Society for Horticultural Science (Chairman, Floriculture and Ornamental Horticulture Section, 1962-63, 1963-1964; Elected as Fellow of Society, 1968)

The American Society of Plant Physiologists

The Holly Society of America

The Royal Horticultural Society

The International Society for Horticultural Science

Western Chapter, International Shade Tree Conference (Honorary Member)

International Shade Tree Conference, Canada (Honorary Life Member)

Publications:

Books:

The Modern Nursery. Co-author with Prof. Alex Laurie, The Ohio State University. The MacMillan Co., 1931

Commercial Flower Forcing. Co-author with Prof. Alex Laurie, The Ohio State University. Blackiston Co., 1934

Bulletins:

Between 1929 and 1967, prepared and published more than 20 Extension bulletins and more than 75 scientific papers.

Honors:

National Arborist Association Life Membership Award, 1950

Norman Jay Colman Award, 1950. "Awarded by the American Association of Nurserymen for Outstanding Contributions to Horticultural Research."

All-America Rose Selections, Inc. Award, 1955. "Awarded on Occasion of Their 25th Anniversary in Recognition and Appreciation of Outstanding Service in the Judging of Roses."

International Plant Propagators Society Award, 1957. "Awarded in Recognition of Outstanding Contributions in the Field of Horticulture and Plant Propagation."

National Arborist Association Certificate, 1957. "In Recognition of Outstanding Research, Leadership, Devoted Service and Interest in the Appreciation and Preservation of Shade Trees."

Jackson Dawson Award, 1958. "Awarded by the Massachusetts Horticultural Society for Contributions to the Science of Plant Propagation."

International Shade Tree Conference Award of Merit, 1963. "Awarded as the Highest Honor given by the International Shade Tree Conference for his Devoted Service and Leadership in the Organization and his interest in the Planting and Maintenance of Shade and Ornamental Trees."

American Horticultural Society Citation Award, 1963. "Awarded for Over 30 Years Service as a Teacher and Research Worker in Ornamental Horticulture at The Ohio State University and for the Several Decades he has Aided the Arborists in this Country by Assisting in the Affairs of their Organizations."

Ohio Nurserymen's Association Distinguished Contribution Award, 1964. "Awarded in Recognition of his Outstanding Contributions to the Nursery Industry."

The Ohio State University, College of Agriculture and Home Economics Council Award, 1966. "In Tribute for Distinguished Leadership to Students and in Recognition of his Wise Counsel and Valued Contributions as a Student Organization Adviser."

The Ohio Agricultural Research and Development Center Certificate, 1967. "In Recognition of 30 Years of Loyal Service to the Center and the State of Ohio."
The Albert J. Wright Award, 1967. "For Significant Service to Organized Student Activities and for Guidance and Counsel in the Development of Effective Student Leadership at The Ohio State University."
The L. C. Chadwick Research Fund, 1967. "Established for the Support of Graduate Student Research in Landscape Horticulture at The Ohio State University by Nurserymen, Arborists and Others Interested in the Horticulture Profession."
Garden Club of Ohio Citation of Merit, 1967. "In Appreciation for Sharing his Wealth of Knowledge with the Garden Club of Ohio, Inc., and for the Rich Contribution he has made to his University, his State and his Nation."
International Shade Tree Conference Author's Citation, 1968. "For Outstanding Contributions to the Profession of Arboriculture."
The Columbus Landscape Association Certificate of Appreciation, 1970. "In Recognition of his distinguished Contributions to the Advancement and Promotion of the Landscape Industry."
The L. H. Bailey Medal, 1973. "Highest Honor given by the American Horticultural Society for Outstanding Achievement in the Field of Horticulture."
The Ohio Agricultural Hall of Fame, 1974. "For Distinguished Service to Ohio Agriculture."

Listed in:

Community Leaders of America, 1971
Community Leaders and Noteworthy Americans, 1974
International Who's Who in Community Service, 1975
Ohio Lives, 1968
Who's Who in the Midwest, 1958
Who's Who in Ohio, 1961

THE BEST OF THE TAXUS CULTIVARS

Dr. L. C. Chadwick
Professor Emeritus of Horticulture
The Ohio State University
Ohio Agricultural Research and Development Center

During the 33 years this project has been in progress, lists entitled "The Best of the Taxus" or "Some Recommended Taxus Cultivars" have been prepared for discussion at several nurserymen's meetings and/or for publication. Such lists have been dated 1950, 1959, 1960, 1962, 1965, and 1974. Changes have constantly been made in these lists as additional data were accumulated and observations made. Any list of this nature must be flexible. New cultivars, some of them superior to existing types, will continue to be introduced, and as they are, inferior types, although common in the trade, should be withdrawn from production.

Nearly 150 accessions have been received during the course of this project. Some were received as rooted or unrooted cuttings and never reached a size suitable for planting in the Taxus Plantation of the Sequest Arboretum. Some accessions were lost during the early period of the project due to poor drainage, and several, while received under a different name, were found to be synonymous with existing or known types. At this stage (1975) of the project, 96 species and cultivars are under study.

The earlier lists were compiled on the basis of limited observations and on catalog or other descriptions. With age, growth habits of several cultivars have markedly changed, and as they matured they varied greatly from early catalog descriptions. As an example, *Taxus cuspidata* 'Adams' was described and introduced as a narrow, upright cultivar. When not restricted by constant pruning, specimens planted in 1942 now measure 13-14 feet in height with a spread of 25-27 feet.

The following list of recommended cultivars is based on observations of the plants in the Sequest Arboretum. Such factors as size, growth habit, hardiness, foliage and fruiting characteristics are considered, along with growth rate and maintenance requirements. Compiling the list on the basis of size and growth habit denotes types which can be used to satisfy the requirements of various landscape designs. Selections are not based on ease of propagation or rapidity of production.

There is no basis for growing an exceedingly long list of cultivars. It is probable that no nurseryman will produce, or landscape contractor use, all the cultivars listed below. Select the best from the list based on regional climatic conditions and landscape demand. Although the recommended forms are based on size and general growth habit, these factors cannot be exact. Dimensions may be exceeded or may not be attained for several years. Under different climatic and soil conditions, growth habits may be variable from that specified.

Some Recommended Taxus

I. Small Types, 1-5 feet in height

1. Low, Spreading Types

Taxus baccata 'Repandens'

Taxus media 'Chadwick'

Taxus media 'Everlow'

2. Slow Growing, Compact, Rounded Types

Taxus cuspidata 'Densa'

Taxus media 'Newport'

3. Slow Growing, Horizontal Spreading Types

Taxus cuspidata 'Nana'

II. Medium Types, 6-10 feet in height

1. Slow Growing, Compact or Rounded Types

Taxus baccata 'Adpressa'

Taxus media 'Emerald'

2. Compact, Broadly Rounded Types--Broader Than High

Taxus media 'Amherst'

Taxus media 'Brownii'

Taxus media 'Densiformis'

Taxus media 'Moon'

3. Compact, Spreading Types

Taxus media 'Berryhill'

Taxus media 'Flemer'

Taxus media 'Natorp'

Taxus media 'Sebian'

Taxus media 'Wardii'

4. Narrow, Upright Types

Taxus media 'Flushing'

Taxus media 'Grandifolia'

Taxus media 'Sentinalis'

III. Large Types, 10 feet or more

1. Compact, Rounded Types--Broad as High

Taxus media 'Lodi'

Taxus media 'Ohio Globe'

2. Compact, Broadly Rounded Types--Twice as Broad as High

Taxus media 'Dutweilleri'
Taxus media 'Halloriana'
Taxus media 'Henryi'
Taxus media 'Runyan'
Taxus media 'Vermeulen'

3. Broad, Upright, Spreading Types

Taxus cuspidata 'Adams'
Taxus cuspidata 'Thayerae'
Taxus media 'Wellesleyana'

4. Broad, Columnar Types

Taxus media 'Costich'
Taxus media 'Hicksii'
Taxus media 'Stovekenii'

5. Broad, Pyramidal Types

Taxus baccata 'Dovastoniana'
Taxus cuspidata 'Capitata'
Taxus media 'Hatfieldii'
Taxus media 'Hill'
Taxus media 'Kelseyi'



DR. JACK L. BEAL
Professor, College of Pharmacy
The Ohio State University

Education:

B. S., 1948, University of Kansas
M. S., 1950, University of Kansas
Ph.D., 1952, The Ohio State University

Experience:

1947-48, Undergraduate Teaching Assistant, University of Kansas
1948-50, Instructor, University of Kansas
1952-57, Assistant Professor, The Ohio State University
1958-62, Associate Professor, The Ohio State University
1963 - present, Professor, The Ohio State University

Professional Societies:

American Pharmaceutical Association; American Society of Pharmacognosy; Academy of Pharmaceutical Science, Society for Economic Botany; Graduate Teachers Section and Teachers of Biological Sciences Section of American Association of Colleges of Pharmacy; Rho Chi, Sigma Xi, Phi Lambda Upsilon, Kappa Psi, Rho Pi Phi (Honorary Member).

Registered Pharmacist:

State of Kansas, 1948 to present

Honors or Distinctions:

Fellow, American Foundation for Pharmaceutical Education, 1950-52
National Science Foundation Faculty Fellow, 1958-59
Edwin L. Newcomb Memorial Award in Pharmacognosy, 1958
Visiting Scientist at University of Baghdad as part of the Cultural Exchange Program between U. S. and Iraq under auspices of an American Specialist Grant from the U. S. Department of State, May 1961

Vice President, 1961-62, and President, 1962-63, American Society of Pharmacognosy
Secretary, 1965-70, Vice Chairman, 1970-71, Chairman-Elect, 1971-72, Chairman, 1972-73, Academy of Pharmaceutical Sciences Section of Pharmacognosy and Natural Products
Academy Fellow, Academy of Pharmaceutical Sciences (1971)
Visiting Scientist, 1963-73, American Association of Colleges of Pharmacy, National Science Foundation Program (19 Universities)
Listed in World Who's Who in Science, American Men of Science, Who's Who in American Education, Leaders in American Science, Outstanding Educators of America, Dictionary of International Biography, Who's Who in the Midwest

Research Work:

Advisor to 12 Ph.D. candidates
Advisor to 12 Master of Science candidates
Associated with 12 Post-Doctoral Research Associates

Principal investigator or co-investigator of the following research grants from National Institutes of Health:

Tumor Necrotizing Activity of Tuberous Begonias, 9/1/61-8/31/68, \$54,856
An Investigation of *Ornithogalum umbellatum*, 9/1/58-8/30/64, \$71,698
A Phytochemical Study of the Genus *Thalictrum*, 9/1/66-8/30/72, \$88,531
A Phytochemical Search for Medicinal Constituents, 9/1/57-8/30/71, \$282,873
A Study of Antibiotics from Higher Plants, 5/1/70-4/30/76, \$174,682
A Phytochemical Study of the Genus *Thalictrum*, 6/1/74-5/31/77, \$68,757

Research Interests:

Isolation and identification of plant constituents; biosynthesis studies; medicinal plant cultivation; assay methods of plant constituents; chemical microscopy

Publications:

82 publications appearing in 20 journals

In the research involving isolation of plant constituents of possible therapeutic merit, 94 different alkaloids have been isolated in crystalline form of which 32 were new alkaloids. In addition, 16 crystalline alkaloids have been isolated which have not yet been named. Also, at least 19 non-alkaloid compounds have been isolated in pure crystalline form.

POISONOUS PROPERTIES OF TAXUS

Dr. Jack L. Beal
Professor of Pharmacy
The Ohio State University

The yew plant has a past history of medicinal use but has no substantial medicinal value today. Through the years it has been used medicinally in treatment of rheumatism, malaria, epilepsy, and heart problems. It has also been used as a laxative and a uterine stimulant. The most often quoted use has been as an abortifacient. Another use attributed to this plant is as an aid to catching fish, in that substances in the plant stupefy the fish, making them easy to catch by hand.

The regard for the yew as a poisonous plant dates back to the writings of Theophrastus, the "Father of Botany", in the fourth century, B.C. A superstition persisting into the eighteenth century that the shade of the yew was deadly to those who slept beneath it is said to have been originated by Andreas, a Greek physician of the fourth century.

There can be no doubt about the poisonous nature of the yew. All species are reported to be poisonous, but there is less documentation for *Taxus brevifolia*. It is regarded in Great Britain as the most dangerous plant. In fact, carelessness in disposing of clippings from yew hedges and trees has been accepted in British courts of law as sufficient basis for action of damages due to loss of stock by neighbors. In this instance, six ewes and eight lambs died as a result of eating some clippings in the spring which had lain on the ground from the previous autumn.

The wood, bark, leaf, and seed of the plant are all poisonous. The older leaf, the shoot, and the seed are the most poisonous.

The toxicity of the plant has been attributed to the alkaloid fraction. Taxine is the name used for the amorphous basic or alkaloid fraction. It was first isolated in 1856, and was believed to be a single entity until the 1950's. Since that time, approximately ten alkaloids have been isolated and designated by suffix letters or numbers, i.e., Taxine I, II, and III, and Taxine A, B, and C.

Some data on the toxicity of taxine are as follows:

LD₅₀ and LD₁₀₀ of 15 and 25 mg/kg, respectively, in mice.

LD₅₀ and LD₁₀₀ of 8 and 15 mg/kg, respectively, in rabbits.

Doses of 0.5-1 mg/kg decreased blood pressure in cats for 20-30 minutes.

Taxine is present in larger quantities in the older leaf (0.18-0.2%) and the seed (0.16-0.92%). There seems to be a seasonal variation, with a maximum content in the winter. The pulp of the fruit can be eaten with impunity, but it is quite bitter to taste. Although the seed is quite toxic, it is of no danger if swallowed whole because no absorption takes place since the seed coat is resistant to digestive enzymes.

Apparently almost all animals are susceptible to the toxic principle in yew, for deaths have been reported in cattle, horses, pigs, sheep, goats, rabbits, reindeer, deer, poultry, pheasant, burros, the ass, the mule, and recently the Brahman bull.

The green foliage has been found toxic to monogastric animals at about 0.1% of the animal's weight, and at about 0.5% of the animal's weight for ruminants.

Most poisonings have resulted from animals eating clippings which have been carelessly discarded. Another major reason for poisonings is due to the fact that the foliage is green all year; in snow-covered areas, the plant may be the most prevalent green plant available to the animal. A few years ago a man near Howard, Ohio, lost about 60 sheep in the month of February because the ground was snow-covered; when the sheep got out of the farm area, they went to some nearby *Taxus* because it was the only green plant in sight. Usually in such instances the animal consumes large amounts of material, causing sudden death without many other symptoms. The animal may be found dead with twigs of yew still in its mouth, or if made to exert itself, may fall suddenly as if it had been shot.

Less severely poisoned animals may display some symptoms before succumbing such as trembling, dyspnea (labored breathing), and collapse. A subacute condition may occur, particularly in cattle. The time between ingestion and production of symptoms may be as much as 2 days in subacute cases. Further symptoms which may be observed in subacute cases are gastroenteritis and diarrhea. The volatile oil in the leaves may cause some of the gastroenteritis.

It has been reported that animals fed on small quantities of yew may acquire a tolerance to it, which may account for the fact the animals introduced into a locality where yew plants grow seem more susceptible than animals living among them.

Human poisoning is infrequent and usually associated with small children attracted to the pretty fruit, eating them and chewing the seed. The summary of January 1973 through December 1973 of cases reported in a bulletin of the National Clearinghouse for Poison Control Centers is as follows:

	<u>Number of Cases</u>
Under 5 years old - - - - -	321
5 years and over - - - - -	25
Unknown ages - - - - -	12
Those under 5 yrs. old who experienced symptoms - - - - -	6
Those under 5 yrs. who were hospitalized - - - - -	2

The next most common cause of yew poisoning in humans is associated with the reported use as a decoction of the leaves as an abortifacient. Symptoms usually appear within an hour as dizziness, dry throat, mydriasis (dilated pupils), abdominal pain, vomiting, muscular weakness, trembling, delirium, facial pallor, purple discoloration of the lips, and slowing of the heart, which ultimately stops.

The primary systemic toxicity of yew is its interference with the cardiac conduction system, usually resulting in a slow, irregular pulse. Hypotension, and then respiratory depression appear secondary to the arrhythmia.

A case history as reported in "Plant Toxicity and Dermatitis" by Kenneth F. Lampe and Rune Fagerstrom is as follows:

"This case involves an adult male who ingested a decoction of *Taxus* needles, apparently to evaluate its effects prior to its administration as an abortifacient for his girlfriend. The material was taken at approximately 2:00 a.m. Somewhere around 3:00 a.m. his brother, with whom he shared a bedroom, thought he heard someone talking. A little before 5:00 a.m., the brother awakened and noticed the patient was unconscious and had a rattling respiration.

"Upon admission to the clinic at 5:25, the patient was deeply comatose. No visible signs of injury by violence were evident. On his pajama top were some signs of spots of bloody discolored sputum. The patient was calm. Worthy of note was the infrequent, gasping respiration. The skin was covered with cold sweat and the face, neck, and entire thorax appeared blue from cyanosis but was otherwise pale. The pupils were alike on both sides, very wide and reactionless. The biceps, triceps patellar and achilles reflexes were not capable of being emitted. The Babinski sign was negative. The peripheral pulse was unperceptible, the heart action very weak with pronounced irregularities and great intervals, the blood pressure was no longer measurable. In spite of immediate therapy with circulatory drugs (catecholamines), the patient died about 5:35 of respiratory failure."

In conclusion, because of the reported toxicity of the yew to animals and the demonstrable evidence that animals eat the plant, a farmer should be rather judicious in the placing of yew in the landscaping of his farm.

Due to the education of the public to the potential toxicity of the yew and because of the distastefulness of the fruit which discourages children from eating it, only infrequent poisoning in humans occurs. Therefore, the yew should not be considered a serious threat and the public should not be discouraged from using it as a landscape plant.

ARIE J. RADDER
Vice President
Imperial Nurseries
Bloomfield, Conn.



Arie J. Radder, born in Boskoop, Netherlands, graduated from the Royal Horticultural College in Boskoop. Prior to coming to the U.S., he received practical experience in his father's nursery as well as leading nurseries in France, Germany, and England.

He has been employed by Yonkers Nursery, Yonkers, N. Y.; Newport Nurseries, Newport, R. I.; and Bagatelle Nurseries, Huntington, Long Island.

Since 1955, Mr. Radder has been employed by Imperial Agricultural Corp. which, at that time, grew 1,400 acres of shade-grown tobacco in the Connecticut Valley. The nursery division started on 1 acre of land and in the past 20 years has grown to approximately 900 acres of field-grown stock and 60 acres of container plants. In addition, a branch in Quincy, Fla., produces an additional 100 acres of container-grown plants.

At present Mr. Radder is Vice President of Imperial Nurseries.

Memberships:

International Plant Propagators Society
American Rhododendron Society, Connecticut Chapter, Committee Work
Two committees, American Association of Nurserymen
Chairman, Legislative Committee, Connecticut Nurserymen's Association

Recognition:

Award of Merit 1975, Connecticut Nurserymen's Association

PRODUCTION OF TAXUS

Arie J. Radder
Imperial Nurseries
Bloomfield, Conn.

Propagation

Propagation of *Taxus* can be divided in propagation from seed and propagation from cuttings. At one time propagation through grafting was used by grafting on *Taxus cuspidata* seedlings. However, since the use of auxins around 1934, the general practice of vegetative reproduction has been from cuttings.

At Imperial Nurseries, we prefer to buy our *Taxus cuspidata* seed directly from Japan. We have found the Japanese ship more viable seed than that we buy from American seed houses. We normally place our order sometime in early June and receive the seed during the latter part of January of the following year. As soon as the seed arrives, we put it in our seed storage area which is a small dry room. We hang our seeds in bags on hooks in the ceiling to keep rodents from getting into them.

Our seedbeds are generally steamed in early April and covered with black plastic. Seeding will start approximately the first week of May. The seed is broadcast in the beds and covered with about one-fourth inch of soil. On top of this, we put a triple layer of cheesecloth to keep weed seeds from blowing in.

Taxus seed has a strong dormancy and will not germinate until the following spring.

We remove the cloth from our beds during the latter part of April of the year following the seeding and cover our beds with snowfencing (50% shade), which we leave on until the following spring.

To keep birds out of the seedbeds, because many birds love to eat the seedlings just emerging, we cover our snowfencing with shade cloth until the seedlings have developed their secondary leaves. Sometimes we use very small mesh poultry netting.

Weed seeds that blow in from adjacent areas and come in through irrigation ponds are a tremendous problem in the young seedling beds, and *Taxus cuspidata* 'Capitata' seedlings are very sensitive to herbicides.

Together with Dr. John Ahrens of the Connecticut Agricultural Experiment Station, we have made some experiments. We have used Caparol 1 lb. active per acre on 1-year seedlings. This is equivalent to 1 gram of active Caparol per 100 sq. ft. We were sure to irrigate the treated seedlings 24 hours after application. Results were excellent, although we were skeptical at first as we got some yellowing of the *Taxus* seedlings. However, they grew out of it beautifully.

We have used dormant fall applications of Asulax at the rate of 4 lb. active per acre and Roundup at the rate of one-half lb. acid equivalent per acre. The weed control with Roundup was even more pronounced than with Asulax; however, the Roundup caused some stunting.

This year we are going to experiment on newly germinated *Taxus cuspidata* 'Capitata' seedlings with Dacthal 5G at the rate of 8 oz. per 100 sq. ft., since equivalent amounts have not caused any harm to newly germinated Pine and Tsuga seedlings.

We keep our seedlings covered on the seedbeds for the first year only. The snowfencing is removed the following March and the seedlings are allowed to grow in the full sun. Our seedbeds are liquid fed during the growing season through the use of a Gewa proportioner with a liquid 10-5-10 at the rate of 2 lb. of nitrogen per acre. We take soil samples every 3 weeks as a check.

The *Taxus cuspidata* 'Capitata' seedlings remain on the seedbeds for 2 years and are transplanted to transplant beds, which I will discuss later.

Propagation from Cuttings

Propagation from cuttings is done mostly during the winter months in heated greenhouses. Cuttings can be rooted under mist during the summer but results are not gratifying. The plants will root very well; however, they become extremely chlorotic, which sets them back considerably and they take a long time to recover. Besides, during the summer all our mist beds are filled with shrub cuttings and ericaceous plants.

Taxus cuttings can be rooted in cold frames during the fall under glass and shades. They will callus up before cold weather sets in and will readily root the next spring. They can be kept in the open frame during the summer and lined out on beds in August-September or kept in the frame until the following spring and lined out on beds. This is generally a good way of propagation for a small grower who cannot afford a greenhouse. In Europe, some growers used horse manure under the rooting medium (which was generally half sand and half soil) in order to get bottom heat, which certainly hastened the rooting.

Generally *Taxus* cuttings are made in the late fall-early winter period. In our nursery in Connecticut, we try to start our *Taxus* cuttings around Thanksgiving time. We use Criterion-type greenhouses and have bottom heat under all our benches. Formerly we had hot water heat in our glass propagating houses, but in the plastic houses, we have switched to Heil downdraft hot air furnaces which blow the hot air through plastic tubes under our benches. The sides and front of the benches are closed in. The ends of the benches are open to enable us to return the cooled off air to our furnaces.

We fill our benches with at least 6 inches of concrete mix sand, which has some coarse particles of gravel in it. The coarse sand is many times more permeable than the finer grade Mason's mix sand. The sand in our benches is used 3 years and thus three crops of *Taxus* are grown in it. To eliminate disease problems, we treat the sand after each crop with formaldehyde. After turning the sand over in the benches, we apply a solution of 1 gallon of formaldehyde to 25-30 gallons of water, cover the benches with burlap for 24 hours (closing the greenhouses completely during that time), afterwards turn the sand again, and allow it to air out for several weeks. People treating the benches with formaldehyde should wear goggles and masks.

We do not keep stock blocks to take our cuttings from. However, we will select blocks of transplanted yews which are not yet ready for sale, trim them up during the fall 1 year before we take the cuttings, and do not trim them again until after the cuttings are taken.

Cuttings are taken several days in advance and dumped on plastic in a cold shed, watered, and used up by the propagation department. We make our cuttings about 8 inches long and strip the needles off the lower 2 inches. Cuttings are then washed in a solution of Malathion and Captan, counted in bundles of 25, tied with a rubber band, dipped up to approximately one-fourth inch in Hormodin #3 powder, and placed in

plastic boxes. Most times we leave them overnight before we insert them in the sand. This is because I have what you might call an idiosyncrasy; I believe that you get better penetration of the auxin then rather than inserting them immediately in the sand.

We control our bench temperature with thermostats. For about 1 week we keep temperatures around 63° F. After that we raise our bench temperature to approximately 68° F. If possible, we like to have all our cuttings stuck before the end of December, because the earlier you stick them, the less top growth you will get. We also make sure that our cutting wood has at least had two or three frosts before we cut them in the field.

All our cuttings are put one-half inch apart on the row and spaced 2 inches between rows.

No shading is put on the greenhouses until the second week of February. After that we shade all our propagation houses with a mixture of gasoline and white latex paint.

Generally speaking, the *Taxus* cuttings need no special attention while rooting, except for normal watering practices. On rare occasions, there may be an area overwatered and infection of *Rhizoctonia solani* may occur. A drench of an oxyquiniline sulfate solution at a concentration of 1:4000 will help the cuttings to recover from the infection. An oxyquiniline sulfate solution of 1:4000 is made up by adding 1 level teaspoon to 3 gallons of water or 1 lb. to 500 gallons of water.

Root initiation generally starts in about 4 weeks and most cuttings are well rooted by February 15. Around March 1, bench temperatures are lowered to 55° and all heat is shut off by April 1. We harden the rooted plants off so we can plant them out by the time all danger of frost is past. Normally we get no more frost in the Hartford, Conn., area after May 18.

Lining Out in Beds

The area where we line out our rooted cuttings and 2-year seedlings is a rather light sandy loam. A nearby irrigation pond is a necessity for us. We cover crop the area for at least one growing season with either Sudan grass or buckwheat. Before planting, soil samples are taken and if pH is too low, sufficient dolomitic limestone is spread to bring pH up to 6-6.5.

After plowing, we normally spread 10-10-10 fertilizer at the rate of 200 lb. per acre. We run a disc harrow over the plowed land and after discing we apply Treflan at the rate of 1-1/2 pints per acre, which we disc in very shallow. We like to wait 1 or 2 weeks after application before we start planting.

We plant with bed planting machines and our planting distance is 6 inches on the row and 9 inches between rows, 6 rows per bed. This gives us a bed width of 45 inches and allows us to roll snowfencing, which is 4 feet wide, over the beds.

Before we roll out the snowfencing, we apply Simazine 80 W.P. at the rate of 1 to 1-1/4 lb. per acre, in combination with Dacthal W 75 at the rate of 12 lb. per acre.

The snowfencing is kept on the 1-year liners until the middle of September to give them a chance to harden up and is rolled back again around November 15 to give them some winter protection.

We apply irrigation when necessary. During the growing season, we apply a total of 900 lb. per acre of 10-10-10 at various intervals, approximately 175 lb. per acre at each application.

Since we are certified for shipment outside the Japanese beetle area, all our land gets treated every 3 years with 10% granular Chlordane at the rate of 80 lb. per acre.

We keep the *Taxus* liners on transplant beds for two growing seasons. The *Taxus cuspidata* 'Capitata' seedlings and the *Taxus* cuttings which came from the seedbeds and cutting benches this Spring (approximately May 15, 1975) will remain on these beds until we plant them out in the early Spring of 1977.

At one time we used to put all our rooted cuttings in the #425 Jiffy pot, which is extra deep (2-1/2 inches round and 3-1/8 inches deep). They were kept in a shade lath area for 1 year and then were lined out in the field any time during the summer in the following year. We gave this method up for a number of reasons, including the extra cost of flats to keep the pots in, the constant irrigation that was necessary, and the fact that after 1 year the pots were pretty well disintegrated and the roots often had penetrated from one pot into another. The plants were lined out with a special planting machine and set out 12 inches on the row, which forced us to transplant them much quicker. With the increasing cost of labor each year, we are looking for ways to cut down our production costs.

At present we leave our plants on the transplant beds for 2 years and undercut them with a bed knife which is 48 inches wide (the beds are 45 inches wide) about 3-4 weeks before transplanting. Immediately after they are undercut, we irrigate the beds to settle the plants back again and generally have some new root initiation by the time we transplant.

We recently purchased a new bedplanter which is quite versatile and allows the spacing on the row to be increased in increments of 3 inches. Our planting distance on the rows in our transplant beds is presently 6 inches. We are contemplating leaving the plants on transplant beds for 3 years, planting distance on the row 9 inches, and undercutting after two seasons and again the following year before transplanting. This will mean a year less in the field in our total production schedule, thus reducing considerable acreage of field planted *Taxus*. The care of 1 year's production in the field and the cost of herbicides, fertilizer, spray material, labor, supervision, etc., also is considerably greater in the field, where plants are distanced 3 feet by 3 feet on 90-foot wide blocks and 15-foot roadways between the blocks, than that planted 9 inch by 9 inch on our bed area. This will give us a considerable saving.

Lining Out of Bedliners into the Field

The land we use for the lining out in field rows should be land that drains fast and drains well. We are fortunate that in the area where we grow *Taxus* most of the land is a sandy loam, except for the river bottom land along the Connecticut river and its tributaries. At the same time, the land must have a certain moisture holding capacity so we won't have to irrigate too much during normal seasons.

Our average rainfall in the Hartford area during the growing season April through September is approximately 21 inches.

The land is prepared by planting a cover crop of Sudan grass or corn the year before planting. The cover crop is plowed under green and if we do not plant in

the fall we cover crop with rye for the winter. The land is plowed 3-4 weeks before planting and soil samples are taken. Our New England soil is fairly acid and since we desire a pH of 6-6.5 for Taxus, we generally have to add from 1-1/2 to 2 tons of dolomitic limestone per acre. Unless the land shows a lack of phosphorus, we do not add any phosphorus at this time.

Planting starts normally around the end of April. The liners which have been undercut previously are lifted from the beds. The tops have been sheared by machine the fall before. Plants are bundled up in wet burlap and brought to a shed where the roots are trimmed. They are then brought to the field where they will be planted by machine.

All fields are divided in 90-foot blocks with 15-foot roadways between. Spacing on the rows is 3 feet and between rows 3 feet. This spacing allows us to run all our equipment through the rows up until harvest time, since all tractor wheels and spray equipment have either shields or rods on springs around them to brush away the loose feathers of the spreading Taxus. Our mechanical planter is a two-row planter with water barrels on them and a device which spurts some water on the roots the instant they are covered. Unless we have a good rainfall immediately after planting, we set up irrigation equipment and irrigate at least twice before removing irrigation pipes. We are fortunate that all our fields have either irrigation ponds, brooks, or rivers nearby.

Before we irrigate, immediately after planting we apply 400 lb. of 10-10-10 granular fertilizer per acre and our weed control crew applies Simazine at 2 lb. active per acre and Dacthal at 9 lb. active per acre. In seasons when soil conditions are rather dry, we prefer to use the wettable powders; in wet seasons, we use the granular materials.

The wettable powders mix readily if you take the materials and mix them in a bucket beforehand, as they are a little difficult to dissolve.

On first-year plantings, we apply 12 lb. Dacthal 75W per acre and 2-1/2 lb. Simazine 80W, or 50 lb. Simazine 4G per acre plus 180 lb. Dacthal 5G.

We make two applications of herbicides per year, Spring and Fall.

The first year of planting, we apply Simazine at 2 lb. active per acre both Spring and Fall. The years after until we harvest we reduce Simazine to 1-1/2 lb. active per acre each application unless we see a tremendous amount of broadleaf weeds coming in our blocks. Then we step up our Simazine to 2 lb.

We cultivate about once every 3-4 weeks if necessary during the summer, but use flat sweeps and install them to run horizontally, not pitched. These sweeps should go not more than 1/2 - 3/4 inch below the surface in order to preserve the herbicide, which will stay in the upper 2-3 inches of soil.

Our present production schedule makes it possible with good growing weather to produce our yews as follows:

Propagation of cuttings	-	Nov. - May
On transplant beds	-	Two growing seasons
Field plant	-	After three growing seasons

We will have very good 12-15-inch spreading yews, with 25% of 15-18-inch size in the blocks.

Some blocks are harvested at the 12-15-inch size and those we grow are root pruned with a U blade. Normally we harvest about 60% 15-18-inch spreading yews the following year and some 18-24-inch sizes. The bulk of the 18-24-inch spreading yews are harvested 1 year later.

The production schedule of upright yews such as *Taxus media* 'Hicks' is on the average 1-2 years longer than the spreaders.

From this schedule, it follows that in the Connecticut Valley we can grow a 12-15-inch spreading yew in 5 years, a 15-18-inch yew in 6 years, and an 18-24-inch yew in 7 years from cuttings.

We grow a columnar upright yew to a 12-15-inch size in about 6 years, a 15-18-inch size in 7-8 years, and an 18-24-inch size in about 9 years from cuttings.

The production schedule of *Taxus cuspidata* 'Capitata' takes a lot longer. Seed of *Taxus cuspidata* 'Capitata' sown in Spring 1975 lies dormant for 1 year, will sprout in Spring 1976, and stay on the seedbeds for two growing seasons. It will be transplanted in Spring 1978 and remain on the transplant beds until Spring 1980, when it will be transplanted to the field. It will be root pruned with a U blade 3 years later and will make a 12-15-inch pyramidal yew by 1984. Since the demand for such a small 12-15-inch pyramidal yew is limited, we will grow them on to a 15-18-inch size by 1985 and a year later they will be 18-24 inches, the most popular size for us. The 2 to 2-1/2-foot capitata yew won't be ready for harvest until 1987. Thus it takes 12 years from the time the seed is sown until the bulk of the crop is harvested. If we have several good growing seasons in a row, we can speed the schedule up 1-2 years.

Fertilization

Yews like a pH of 6-6.5. Since our Connecticut soils run normally between 5-5.5, we constantly have to add lime to our growing fields. Before planting a crop, our soil is analyzed and when necessary brought up to the desired pH by sowing and incorporating in the soil dolomitic limestone. During the growing of our crop, we quite often find our pH going down, and in those instances we broadcast either dolomitic lime or hydrated lime over the plants with either a Lilly or Gandy spreader. I've often felt that the need of lime is as great if not greater for optimum growth and color of yews than fertilizer, because nothing stunts the growth as much and makes the yews look yellower than the lack of lime.

Our fertilization during the growing season in the field consists of 90 lb. of nitrogen per acre per year, generally in the following application: 400 lb. 10-10-10 in late March, early April; 300 lb. 10-10-10 during late June, early July; and 200 lb. 10-10-10 after all growth has stopped. This is generally during the last week of October or early November in Connecticut, when air temperatures are cooler and soil temperatures in the root zone are still in the 40-50° F. range.

We keep this practice up from planting time until harvest time. We find that the fall fertilization aids the color; if they are not fed in the fall, the needles have a tendency to turn reddish brown during the winter and consequently make the plant unattractive when harvested early in the Spring.

Disease and Pest Problems

Yews are comparatively free from fungus diseases. The main disease problem we have encountered has been *Rhizoctonia solani* in our cutting benches when there has

been some overwatering or drip from leaks in the greenhouses, and on our transplant beds and growing fields during extremely long rainy spells when the soil is not an easily drained soil type. Soil applications of oxyquiniline sulfate generally check the dying of trees quickly. When infection is severe, two or three applications a week apart are quite successful.

Several plant pests will attack *Taxus*.

The blackvine weevil (*Brachyrhinus sulcatus*) and the strawberry root weevil (*Brachyrhinus ovatus*) attack the roots in the larval stage and chew on the needles as adults. The best control for us has been a spray with a 72% chlordane emulsion at the rate of 1 pt. per 100 gals. of water per acre, applied to the point of runoff.

Japanese beetles (*Papillia japonica*) also will attack the roots of *Taxus*. However, they can be controlled by applying 8 lb. of technical chlordane per acre. Treatment is effective for 3 years.

Although nematodes are not a very big problem, we have our lots checked yearly by the Connecticut Agricultural Experiment Station. The latest report shows the following:

Newly planted Yews	0 nematodes per 5/yr. soil
Harvested Yews on loading area	0 nematodes per 5/yr. soil
2 yr. transplanted Yews	0 nematodes per 5/yr. soil
7 yr. old Yews	0 nematodes per 5/yr. soil
12 yr. old <i>Taxus cuspidata</i> 'Capitata'	24 meadow or lesion nematodes
9 yr. old Yews	4 stilet nematodes

The only field with an appreciable amount of nematodes was one field with 12-year-old *Taxus cuspidata* 'Capitata' with 24 lesion nematodes. Even then we were not sure whether a drench of the soil around the plants with a nematicide would really help growth or not.

Other pests are mealybugs (*Pseudococcus* sp.), two-spotted mites, and scale. We keep a constant vigil and if mealybugs appear, we go on an intensive campaign starting May 1 with Ethion oil, 2 qts. per 100 gals. per acre, followed by the same on May 15. If any eggs hatch during the summer, we spray with Sevin or malathion with a surfactant and generally get good control. Two-spotted mites are sometimes found on *Taxus cuspidata* 'Capitata'. Two sprays of Tedion at the rate of 1 pt. per 100 gals on June 15 and repeated on July 1 have given us excellent control.

Fletcher scale (*Leucanium fletcheri*) has been found on *Taxus cuspidata* 'Capitata' and Hicks. There is generally one generation a year in Connecticut. Eggs are deposited through June and hatch in about 10 days. Spray with Ethion oil at the rate of 2 qts. per 100 gals. and a pump pressure of 400 p.s.i. has been very successful.

Cultivars Grown by Imperial Nurseries

At one time we grew quite a few *Taxus* cultivars. However, we have eliminated the bulk of them for several reasons, including economics, similarity of cultivars, and cultural problems. We have grown the following cultivars:

Taxus baccata 'Fastigiata Robusta'

Taxus baccata 'Repandens'

Taxus cuspidata

Taxus cuspidata 'Andersoni'

Taxus cuspidata 'Capitata'
Taxus cuspidata 'Densiformis'
Taxus cuspidata 'Greenwave'
Taxus cuspidata 'Henryi'
Taxus cuspidata 'Hiti'
Taxus cuspidata 'Kersbergen'
Taxus cuspidata 'Nana'
Taxus cuspidata 'Nigra'
Taxus cuspidata 'Sieboldi'
Taxus cuspidata 'Thayerae'
Taxus cuspidata 'Vermeulen'
Taxus cuspidata 'Wardi'

Taxus intermedia
Taxus intermedia 'Sebian'

Taxus media 'Bloodgood'
Taxus media 'Brown'
Taxus media 'Halloran'
Taxus media 'Hatfield'
Taxus media 'Hicks'
Taxus media 'Kelsey'
Taxus media 'Moon's Columnaris'

Our present production schedule consists of only seven varieties. These were chosen because of either demand by our customers or fast production time to maturity or a combination of both. They are:

Taxus cuspidata 'Densiformis'
Taxus cuspidata 'Greenwave'
Taxus cuspidata 'Kersbergen'

Taxus media 'Hatfield'
Taxus media 'Hicks'
Taxus media 'Brown'

Taxus cuspidata 'Capitata'

The bulk of our production is in *Taxus cuspidata* 'Densiformis.' This cultivar has been and is the biggest moneymaker on the wholesale level for us.

Rootpruning

Rootpruning is a practice which is absolutely necessary for the commercial grower. It is necessary to develop a fibrous root system and assure survival of the plants when dug for sales.

Rootpruning starts when the rooted cuttings come from the propagation benches, is continued on the transplant beds when the plants are undercut with a sharp bed knife behind a tractor, and is continued at intervals during the time the plant remains in the field until it is harvested. In the field, rootpruning is accomplished either by transplanting or by undercutting the roots with a U blade, preferably early in the Spring.

Pruning and Shearing

Pruning is necessary because first of all very few trees will grow by themselves exactly as we would have them as an attractive saleable plant.

Taxus in our nursery are pruned either by machine or hand shears. All our spreading yews and our broad columnar upright yews are pruned by machine and only the loose feathers which the machine trimmer skips are trimmed by hand as a follow-up.

The machine which we use at Imperial Nurseries is a 130 Farmall tractor with a side attachment consisting of an armor plate-type platform which can be raised and lowered hydraulically. We fasten a 7 H.P. Briggs & Stratton engine with a straight crankshaft to the platform, drill a hole through the plate for the crankshaft, and attach a 30-inch mower blade. I have some slides which show the mower in action. We use a Woods Cadet 60 on our transplant beds, a mower and brush-cutter with a 60-inch blade which runs off the power takeoff and is pulled by a tractor with constant power takeoff. The cutting height on this rotary cutter ranges from 1 to 14 inches. All our spreading and columnar upright yews are trimmed once the first year on the beds and at least twice or three times the second year to develop a broad base before transplanting into the field.

Once in the field, they are cut once during the summer and loose feathers are hand trimmed, except for the year before they are sold. Then we trim in the fall and plants are not touched by machine or handshears except for some dead branches. This gives us full-bodied, well-feathered plants the following autumn.

Taxus cuspidata 'Capitata' are not touched at all while on the transplant beds and are never pruned by machine. They are pruned by handshears once during the growing season and are touched up lightly once more before they are sold in the fall.

Containerizing Yews

Some customers would rather have Taxus in pots than B & B. Field-containerized yews, as we call them, are dug in August, put on an area which can be irrigated, and are put either in sheds or in plastic hoop houses over winter. This allows us to sell part of our production a lot earlier in the Spring than field dug material.

For several years we also have grown yews in containers, both directly from the cutting bench and from the transplant beds. I feel that we can grow a good plant about as fast in the container as in the field as long as we use a growing mix which has good percolation. As soon as we find a better customer acceptance of this particular product, we will increase our container grown production of Taxus in the 12-15-inch and 15-18-inch sizes considerably. We find the advantages such as space saving, ease of handling, immediate availability (no harvesting needed), easier loading, to name a few, far outweigh any disadvantages which may exist.

CLARENCE E. LEWIS
Professor Emeritus of Horticulture
Michigan State University



Education:

B.S., Cornell University
M.S., Hofstra College

Employment:

Landscape Architect, U.S. Department of Agriculture, 1935-37
Associate Professor of Horticulture, State University of New York at Farmingdale,
Long Island, 1937-57
Lecturer, Plant Ecology, New York University, New York City, 1943-54
Professor of Horticulture, Michigan State University, 1957-72
Professor Emeritus, Michigan State University, 1972 - present
Advisor - Visiting Committee, Longwood Gardens, Kennett Square, Pa.
Plant Selection Committee, American Association of Nurserymen
Sponsor, Cornell Plantations, Cornell University
Advisor, Fernwood Arboretum, Niles, Mich.

Articles and Photographs:

More than 500 articles and 1800 photographs

Regular contributor to: American Forests
New York Times
Horticulture
American Nurseryman
Brooklyn Botanic Garden "Plants and Gardens"
American Horticulture Society
Cornell Plantations
New York Botanical Garden Journal
University of Washington Arboretum

Brochures and Bulletins:

Selective Tree Planting, Long Island Lighting Company, New York
Guest Editor, Brooklyn Botanic Record
Guest Editor, American Association of Botanical Gardens and Arboreta
Revised Book, "Evaluation and Selection of Shade Trees," International Shade Tree Conference, Inc.
Revised Booklet, "New Pronouncing Dictionary of Plant Names," American Nurserymen's Association
Revised Horticultural Section of "American People's Encyclopedia"
Various Bulletins, Michigan State University
New York Times Garden Book
New York Times Book of Home Landscaping

Memberships:

International Shade Tree Conference, Inc. (Chairman, Tree Selection and Evaluation Committee)
American Horticulture Society (Chairman, Awards and Citations Committee, and Board of Governors)
American Rhododendron Society
Royal Horticulture Society
American Holly Society
American Society for Horticultural Science
Garden Writers of America
American Association of Botanical Gardens and Arboreta

Honorary Memberships:

Society of American Landscape Nurserymen
National Association of Gardeners
Michigan Association of Nurserymen
Michigan Forestry and Parks Association (Advisor)
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Awards:

Author's Citation, International Shade Tree Conference, Inc.
Award of Merit, International Shade Tree Conference, Inc.
Teaching Citation, American Horticulture Society
Outstanding Teacher, College of Agriculture, Michigan State University
Special Award, Michigan Forestry and Parks Association
Michigan Horticulture Society

Currently lecturing to various organizations, both professional and university groups, on any phase of Ornamental Trees and Shrubs, as well as English Gardens.

EFFECTIVE USE OF TAXUS IN THE LANDSCAPE

Clarence E. Lewis
Professor Emeritus of Horticulture
Michigan State University

No genus of narrow-leaved evergreens is as plush and rich looking as Taxus. It fits so many planting situations, and has a great diversity of plant forms which can be made to conform to nature's or man's landscape. Shade and full sunlight present no problems as long as the right yew is chosen and good soil drainage and organic matter are provided.

One of the most common uses is the hedge, for which a great many varieties and cultivars of Taxus can be selected. Hedges need not always be stiff in appearance. They can curve in an irregular manner to emphasize informality, or follow the lines of buildings, walks, and gardens. Hedges accent and complement.

A yew hedge can frame, emphasize, or direct your attention to something of greater importance--such as good architecture. It also blocks unwanted traffic from certain areas, and screens for privacy of the eye and ear.

For variety in a hedge, more than one cultivar or variety can be selected, but do not make it a hodge-podge. For instance, if you are making a hedge 50 feet or more long, choose one, or possibly two, which are different than the main plants. Use three to five of each odd or different selection in a group, but do not place them alternately as individuals. Arranged together, these do not make a great change in the hedge's appearance, but add a bit of variation and only a slight, but noticeable, contrast. Yellow might be a questionable cultivar, but even this is not impossible in the right situation.

Compare a yew hedge with less expensive deciduous shrubs, like privet. Then think of all the other attributes a Taxus hedge has. It has foliage the whole year, and the length of life is much longer. It also has a richer green and a more interesting texture to blend or compare with other plants and structures.

Distance can be foreshortened or accentuated by doing the following. If you wish to foreshorten, then have the distant end of the yew hedge taper (or bend) slightly toward the inside. In reverse, if the distance is to be made greater, then have the hedge bend slightly away from the line of sight. In addition, to accentuate distance, make the hedge slightly lower at the distant end, and in reverse if you want to shorten the distance.

Also, have the fine textured yews at the distant end and coarser ones near the home to emphasize distance. The opposite effect works in reverse. By widening the hedge at the viewing end and narrowing it slightly at the furthest end, again distance is emphasized and the reverse is also possible.

Yews as hedges or individuals which follow the lines of commercial buildings and funeral homes provide a finished, business-like effect. They are simple, neat, and lush in appearance, and psychologically create satisfaction and confidence in clients and visitors.

Taxus provide better backgrounds for perennial and annual borders, because the fibrous root systems are concentrated. A privet hedge has roots which run in to the border to compete vigorously with the root systems of the garden plants.

Yew hedges are, or can be, the backbone and strength in garden borders which require partitioning. The crisp lines accentuate the flowers displayed. It is well to have the cross hedges which form the garden compartments lower than the background yews. These come in at right angles and need not all be of the same height. If the distant ones are lower than the nearby ones, then the border seems longer; in reverse, if the ones furthest from the viewing entrance are taller, then the opposite is true. The border seems not quite as long.

All the background, but particularly the vertical or cross hedging, need not be *Taxus*. For variety, occasionally use white pine, Convex leaved Holly, American Holly, Burford Holly, selections of American Arborvitae, or Dwarf Hinoki Falsecypress.

Geometric patterns like those found at Blenheim Palace, at Woodstock, Oxfordshire, England, and Versailles, near Paris, France, are good examples of what *Taxus* can do to create patterns in gardens. It would not be difficult to do the same on a much smaller scale.

Topiary work is another use of yews where dogs, peacocks, bears, bell towers, etc. have been created by pruning shears in the talented hands of a craftsman. These are not for many gardens, but can be and are effective in some American gardens and many gardens in Great Britain, such as Nyman Gardens, Handcross, Sussex County, and Levens Hall near Kendal, Westmoreland.

We begin to see the great diversity of *Taxus* and its many facets. We can thank a great many men for introducing so many forms, some with varying texture, others with different intensities of green, and many with an irregularity and formality of branching structure.

Taxus conform easily into espaliers, and almost any variety can be pruned and structured into various forms on walls or the sides of buildings. The sizes and heights can be varied, and they respond willingly to your pruning shears. It is often a good idea to form your espalier on horizontal wires before placing it in the landscape setting. Occasionally a nursery does this.

Bank planting presents no problem because the fibrous root system of the yew adjusts readily if the drainage is good and the organic matter is abundant. Again, the selection is important, and even questionable if the slope is excessive. Full sun and deep shade also regulate your choices. Deep shade is one place where our native Canadian yew (*Taxus canadensis*) adapts itself, even the areas of low hemlock branches and quite intense slopes. The question usually is where do you buy them--and collecting is a problem. If they are existing in a woodland--fine.

Block plantings to prevent people from following the shortest distance between two points and guiding people in the direction you wish them to go is a very effective *Taxus* use. If this block is too low, there is a tendency for some types of people to accept the challenge and trundle their way through. The wider and higher the block, the less these individuals will accept the challenge. The rows should be at least three in number, and four or five is a better number. This is a way to direct circulation, public or private.

Cemeteries find *Taxus* to be a well accepted genus. Yews with their lush green and willingness to be restrained add dignity to burial grounds. They create the reverence which is needed.

There are a lot of reasons for selecting *Taxus* for cemetery plantings. Where the markers are flat, gardens can be created, and in some places they are. But where there are stones of all sizes and shapes, yews can be made to conform to such, and to complement the particular shape of an upright or irregular stone marker.

It is well to remember that the stone was the important thing in the mind of the person who had it erected. A stone is like good architecture, and is to be complemented, without the planting being dominant.

Sheared yews are sometimes very much in keeping. Yews placed behind the marker are sometimes the effective treatment. A simple garden area dominated by the rich green of yews makes the grave a place where relatives are more willing to visit and the cemetery more attractive.

Planters become a receptive place for *Taxus* as long as they are well constructed and the plants are cared for. It is an effective way to treat this structure which may be part of a home, office building, or a back living area.

Remember that winter is something which should be considered. It is pleasant to be able to look out of your most used rooms, such as a family room, and see the rich green of yews. It is even more important to combine these yews with such attractive barked trees or shrubs as Japanese Stewartia (*Stewartia pseudo-camellia*), Paperbark Maple (*Acer griseum*), Westonbirt Dogwood (*Cornus alba* 'Westonbirt'), River Birch (*Betula nigra*), or Paper Birch (*Betula papyrifera*).

There are so many ways to use *Taxus*. When the distant view is emphasized by the sharp line of a *Taxus* hedge, and you look through or under the branches of a tree, the view is not only more noticeable, but is framed, and you are compelled to enjoy this waterfall, distant mountain, green meadow, or whatever it may be. Attractive branches which loosely overhang a well-defined, sharp, yew hedge become even more interesting, as do flowers of a Rhododendron directly in back of such a rich green yew wall.

Yews soften rustic logs or guard rails used in parking lots. They do the same for stone or concrete walls, but don't hide them because someone paid good money for their construction.

Taxus do not conflict with the colors of annuals, perennials, or the flowers of such small trees as flowering crabapples. They combine with a great many shrubs, trees (large or small), and ground covers.

The yew as a single specimen in a planting is also a good choice, providing it is allowed to grow more or less naturally. The lower, spreading, or semi-spreading types are the simplest to employ in the landscape. Upright forms, too, can be used if they are not arranged as tight-clipped specimens, except like the ones in the formal gardens so long evident in Europe and Great Britain.

There is no end to effective use of *Taxus* in the landscape. It is one of the best means of creating unity in the landscape, by the repetition of *Taxus*, so that your attention is directed to this genus over and over again.



HAROLD G. HILLIER
Hillier & Sons
Winchester, England

Harold G. Hillier has been working in the family nursery business ever since leaving school at the age of 17. The business was started in 1864 by E. L. Hillier, the grandfather of H. G. Hillier. On the 700 acres, there are about 16,000 kinds of plants of the temperate regions, most likely more than any other nursery. Hillier's Manual of Trees and Shrubs is probably the most comprehensive nurserymen's catalogue ever written of which the arboretum is a living emblem.

Honors and Recognitions:

Warrant of Appointment as Nurseryman to Her Majesty Queen Elizabeth, The Queen Mother
Appointed a Commander of the British Empire in Recognition of Services to Horticulture
Honorary Life Fellow and Vice-President, Royal Horticultural Society
Victorian Medal of Honor, Royal Horticultural Society
Veitch Memorial Medal in Gold, Royal Horticultural Society
Winner of the Loder Rhododendron Cup
Winner of the Lawrence Medal three times for the best exhibit show to the Royal Horticultural Society during the year
Winner of a Chelsea Flower Show Gold Medal for 28 consecutive years

Memberships and Activities:

Windsor Park Consultation Committee
Council of the Royal Horticultural Society
Councillor of the Horticultural Trades Association
Royal English Forestry Society
Royal Scottish Forestry Society
Director of the International Camellia Society
Councillor of the International Dendrological Society
Director of the Conifer Exhibit at the 1969 London Conference at which Hilliers exhibited more than 900 different sorts
Annual exhibitor at the Chelsea Flower Show
Judge and exhibitor at many leading European flower shows

TAXUS SPECIES AND HYBRIDS

Harold G. Hillier
Hillier & Sons
Winchester, England

Taxus baccata L. Since with the yew we only boast three native evergreen trees, you must allow me to refer to the Common Yew as English. The yew is an ancient tree rivaling the Redwood and Sequoiadendron in its longevity. The male and female strobili are usually on different trees, rarely on the same individual. While the female flowers are insignificant, the enormous amount of pollen produced by the male flowers is conspicuous during March and April when the air in the vicinity of a male tree is clouded with yellow pollen. The comparatively showy red fruits ripen from October to December.

It varies in height from 35 to 75 ft., rarely more, and develops massive trunks exceeding 30 ft. in girth.* It is generally regarded as extending through Europe to Persia and North Africa. In fact, it is open to doubt as to whether several if not all other species excepting *T. celebica* should be regarded as sub-species or geographical varieties of *T. baccata*.

Taxus brevifolia Nuttall. This has been shown to me in its native habitat and I really cannot see how it differs from *T. baccata*. The name is unfortunate since the leaves are the same length and shape as an average yew; in fact, several forms of *T. baccata* have much shorter leaves.

Taxus canadensis Marshall. The Canadian Yew is seldom seen in Europe in its typical semi-prostrate form. The plant usually so labeled is cv. "Pyramidalis" ('Stricta'), which forms a dense compact bush eventually to about 5 ft.

Taxus celebica L. (*chinensis*). Apart from *T. baccata* and its appendages, this is the only obviously distinct species which, in the absence of fruit, one may be forgiven for placing under *Torreya* or even *Cephalotaxus*. I remember some years ago debating in my mind as to whether a plant I had been asked to identify was the "Chinese Yew" or *Torreya grandis*. A typical academic botanist's name since it is the least grand of all the *Torreya*s!

The comparatively large polished leaves are about 1-1/4 in. long, being widely spaced from one-half to three-fourths in. apart. A specimen planted in our arboretum 20 years ago is now 10 ft. x 18 ft.

Taxus cuspidata Sieb. & Zucc. The "Japanese Yew" in its native habitat is a large shrub or small to medium sized tree which as seen cultivated in Europe is decidedly less attractive than the English Yew. In fact, if you see a rather miserable, somewhat yellowish yew in a plantation of *T. baccata*, the chances are you are looking at *T. cuspidata* with its stiffer, less-flexible branches and more yellowish-green leaves. I understand the only advantage of *T. cuspidata* and its hybrids is that it is more resistant to cold and is therefore better suited to really severe continental winters.

Taxus floridana Chapman. This interesting species of restricted natural distribution has with us attained 4-1/2 ft. x 6 ft. in 17 years. This is decidedly smaller

*The notes given here related to size mostly refer to plants on rather sandy acid soil. They would be larger growing in a deep loam over chalk.

than a typical *T. baccata* which in the same time would be three times the size. The leaf is very like that of the English Yew. The young stems are lemon-green in color.

Taxus globosa Schlechtendal. A tree to about 20 ft. discovered in 1837 in S. Mexico. Dallimore and Jackson comment that the "foliage of specimens they have seen so labeled differ but little from *T. baccata* except that the leaves are somewhat larger and more sharply pointed." I have not seen this plant, which does not appear to be in cultivation in Europe.

Taxus x *hunnewelliana* Rehd. (*canadensis* x *cuspidata*). A vigorous, large, very wide-spreading shrub with obtusely ascending branches and an open center. It resembles one of the wide-spreading forms of *T. x media* from which it differs in its longer, narrower, deep green leaves. A specimen in our arboretum planted in 1954 is now 10 ft. high and 20 ft. across. Raised in the Hunnewell Pinetum, Wellesley, Massachusetts.

Taxus x *media* Rehd. (*baccata* x *cuspidata*). A vigorous, medium-sized to large shrub or small tree intermediate between the parents. Leaves are usually two ranked. Among the various named clones, some develop a peculiar twisted character in the branches, shoots, and older leaves. Raised about 1900 by T. D. Hatfield of the celebrated Hunnewell Pinetum. I understand for severe winter climates this hybrid proves hardier than *T. baccata*. There are numerous cultivars giving much the same degree of difference as the cultivars of *T. baccata*.

Taxus wallichiana Zuccarini. The "Himalayan Yew" extends eastwards from Afghanistan along the Himalaya. Dallimore and Jackson state that examples from the Philippines appear similar.

I was speaking recently at Kew to Anthony Schilling, who has seen this plant in the wild. He states it does not superficially appear to differ from *T. baccata*.

Taxus chinensis Florin (*baccata* var. *sinensis* Henry). Native of Kansu, Szechwan, Hupeh, and Yunnan. Dallimore and Jackson state that "most authors regard this species and its variety as a sub-species of *T. baccata*. However, it seems to be as distinct as other species of *Taxus*." I have not seen this plant, which probably is not in cultivation in Europe.

Having made reference to the species and their hybrids, I will briefly comment on some of the cultivars grown in the British Isles and Europe. Most no doubt are old friends of yours.

Taxus baccata 'Adpre'ssa'. One of the most readily recognizable of all cultivars with small, dark green, pectinately arranged leaves about one-fourth in. long and comparatively broad.

Taxus baccata 'Adpressa Erecta' ('Adpressa Stricta'). A taller shrub with branches less spreading. A specimen in our home nursery has attained about 19 ft. x 14 ft. in 60 years.

Taxus baccata 'Adpressa Variegata' ('Adpressa Aurea') is very much one of my favorite golden variegated evergreens. The primary branches are at an obtuse angle which tends to create an almost basin-like appearance. A specimen in the arboretum at 17 years old is 6 ft. x 11 ft.

Taxus baccata 'Amersfoort'. I first met this plant when a small twig was sent to me for identification. I replied I was not familiar with this specimen, which superficially looked as though it might be either a *Taxus*, *Podocarpus*, or some obscure *Hebe*. A specimen was sent to an authority in New Zealand, whose name I unfortunately forget, but the lady replied "definitely an unusual form of English Yew." I understand the original plant is in a hospital garden in Amersfoort, Holland. I regard this as one of the most exciting of the yews and a plant which should be in every large garden. The curious, short, thick, oblong-inclined to obovate leaves are about one-fourth in. long and terminate in a mucronate apex with an inrolled margin.

A plant in our scree garden is an irregular small bush with four primary stems at a fairly acute angle. Height 3 ft. x 2 ft. 6 in. wide at the age of 8 years.

Taxus baccata 'Argentea Minor' ('Dwarf White'). This interesting dwarf yew we originally received as cuttings from Kew 15 years ago. Our best specimen, as shown on a slide, is about 2 ft. high and 4-1/2 ft. wide. The leaves have a conspicuous marginal band which in the young leaves is cream colored, passing with age to a silvery white. The leaves are of typical shape and size.

Taxus baccata 'Aurea'. This may be regarded as the type plant of the Golden Yews. A large dense shrub with yellow leaves which turn green the second year.

Taxus baccata 'Cavendishii'. A female form which in 17 years has attained 5 ft. x 10 ft. with wide-spreading branches drooping at the tips. Eventually forms a semi-prostrate mound. Like others of this shape, a splendid ground cover for a shaded site.

Taxus baccata 'Cheshuntensis'. A semi-erect female clone, in shape intermediate between the Common and Irish Yew. Raised in Pauls Nursery at Cheshunt about 1857. In 17 years it has reached 10 ft. x 9 ft.

Taxus baccata 'Compacta'. One of three dwarf forms raised by Den Ouden of Boskoop. It is freer growing than 'Pygmaea' with longer leaves and forms a more densely flat-topped bush, attaining 1-1/2 ft. x 2 ft. in 10 years.

Taxus baccata 'Contorta'. A curious wide-spreading bush, the branchlets and leaves twist and turn in all directions like some forms of *T. x media*.

Taxus baccata 'Decora'. A dwarf, slow-growing shrub forming a flat-topped hummock with arching branches and comparatively wide, dark green, upward-curving leaves.

Taxus baccata 'Dovastoniana'. "Westfelton Yew". A very distinct, fast-growing, wide-spreading tree with tiers of long, horizontal branches pendant at their extremities and with subsidiary weeping branchlets. The original tree planted in 1777 is at Westfelton in Shropshire. This cultivar should be trained as a single-stemmed tree. In 17 years it has attained 16 ft. x 13 ft.

Taxus baccata 'Dovastonii Aurea'. This male clone raised in France is similar to 'Dovastoniana' but usually of lesser stature and its leaves are conspicuously margined yellow. It has reached 6 ft. x 15 ft. within 17 years. Given an open position on a lawn, it is certainly a spectacular specimen.

Taxus baccata 'Elegantissima'. The most popular of the golden yews in England. A dense-growing, large, female bush with ascending branches and yellow leaves

which later pass to straw yellow, when the color is confined to the margin. In 17 years its size is 10 ft. x 10 ft.

Taxus baccata 'Erecta'. A broadly elliptic bush stated to be a seedling of the Irish Yew, although no marked evidence in the leaf. The form 'Overeynderi' seems the best of the 'Erecta' group. A female cv. in 17 years 11 ft. x 9 ft.

Taxus baccata 'Fastigiata'. The "Irish Yew". There were two original trees found by farmer Willis about 1780. The one which he planted in his own garden died in 1865, but the other which he gave to The Earl of Enniskillen is still at Florence Court in Northern Ireland. I visited this tree with my father in 1923. This tree is less spectacular than some of its progeny. This is probably due to its initial transplanting from the wild and to some extent suppresion from surrounding trees.

The Irish Yew will attain about 50 ft. x 20 ft. and is the best formal evergreen tree belonging to the cooler temperate regions. It has been extensively used in the best formal gardens of the British Isles. Some may query my statement, which I have made on the spur of the moment. The Italian Cypress is less hardy and so too are the numerous forms of *Chamaecyparis lawsoniana*, nearly all of which are less rigid and more subject to snow damage. The original clone is female, but male clones now exist.

Taxus baccata 'Fastigiata Aureomarginata'. The "Golden Irish Yew" is a male clone. In 17 years it is 10 ft. x 3 ft.

Taxus baccata 'Fastigiata Standishii'. A smaller, slower growing, narrower form. A most attractive plant, the best of its color and habit. Female. In our garden it has reached 5-1/2 ft. x 12-15 in. in 12 years.

Taxus baccata 'Glauca' ('Nigra'). "Blue John". A male form of loose yet fairly upright habit. The young unfolding leaves are decidedly glaucous, passing to almost black-green. When the male strobili shed their pollen, the air around is clouded. In 17 years, 11 ft. x 8 ft.

Taxus baccata 'Jacksoni' ('Gracilis Pendula'). Probably only a selected clone of cv. 'Dovastoniana'.

Taxus baccata 'Lutea' ('Fructuluteo') ('Xanthocarpa'). A shrubby form usually wider than high. Certainly attractive when carrying its chrome-yellow fruits. In 17 years 9 ft. x 8 ft.

Taxus baccata 'Nana'. A tiny, slow-growing bush of compact habit attaining 1-1/2 ft. x 1-1/2 ft. in 10 years.

Taxus baccata 'Neidpathensis'. The male Neidpath Castle Yew is not very distinct. The acute angle of branching makes a comparatively upright tree, taller than broad. In 17 years 11 ft. x 8 ft.

Taxus 'Nutans'. A small, flat-topped bush. Leaves variable, often small and scale-like. 1-1/2 ft. in 10 years.

Taxus baccata 'Pygmaea'. A small, ovoid, compact bush, perhaps the smallest of the English yews. Raised in Holland.

Taxus baccata 'Repandens'. A low-growing, semi-prostrate, female bush with long spreading branches pendant at the tips. A good ground cover for dense shade.

Taxus baccata 'Repens Aurea'. A very effective, low-spreading, comparatively vigorous ground cover. In all probability a propagation from a low, leaderless branch of 'Dovastonii Aurea'. Like other golden plants, it loses its color in dense shade, but does not burn in the hottest sun we get in the U.K.

Taxus baccata 'Semperaurea'. Male. Perhaps the best golden yew for a small garden. A bush of slow growth and compact habit. Decidedly old gold rather than the yellow of 'Elegantissima'. A bush in our arboretum in 17 years has attained 7 ft. x 9 ft.

Taxus baccata 'Variegata'. A slow-growing, wide-spreading, female bush rather like a small Pfitzer Juniper. The silver marginal variegation is not very conspicuous. In 17 years 4-1/2 ft. x 7 ft.

Taxus baccata 'Washingtonii'. A moderate size female clone with semi-erect primary branches. In color it is old gold similar to cv. 'Semperaurea', but is of more open and angular habit of branching, never so dense a bush. In 17 years 7 ft. x 13 ft. In older nursery catalogues, it was erroneously referred to as *T. canadensis*.

Taxus cuspidata and its cultivars are not generally planted in the British Isles. Apart from the collector, they have no advantages over the long-established forms of *T. baccata*. The following sorts are represented in British gardens.

Taxus cuspidata 'Aurescens'. With us this plant, which can look very exciting with its brilliant yellow young leaves, has proved unsatisfactory, being a plant of weak constitution and scorching in the full sun.

Taxus cuspidata 'Contorta'. Shoots and branches twisted.

Taxus cuspidata 'Densa'. A dwarf, compact, female clone forming a mound of crowded erect stems.

Taxus cuspidata 'Minima'. An extremely slow-growing, small bush of irregular habit.

Taxus cuspidata 'Nana'. A wide-spreading bush with stout branches and many short side branchlets, leaves radial. In 17 years 4-1/2 ft. x 9 ft. This form has been grown by English nurseries for many years.

Taxus x media 'Brownii'. A male form usually wider than high with semi-erect branches and rather long, somewhat contorted leaves.

Taxus x media 'Hatfieldii'. A compact male form with erect branches. In color and leaf form, it appears intermediate between the parents. An excellent hedging plant. In 17 years 10 ft. x 8 ft.

Taxus x media 'Hicksii'. This is a pleasing female cultivar inclined to *T. baccata* and of comparatively erect habit. In 17 years 11 ft. x 10 ft.

Taxus x media 'Sargentii'. A female form inclined towards its English parent. In 20 years it has made a semi-erect shrub 13 ft. high and 12 ft. wide.

Taxus x media 'Thayerae'. A broad, vigorous, male shrub with widely ascending branches and open center. In habit not unlike *T. x hunnewelliana*, but with shorter, broader leaves.

In the British Isles, dendrologists debate as to whether our native flora includes 26 or 29 species of trees. Be that as it may, I have observed that in a few acres of your country you have more woody plants than we have in our entire country or in any thousand miles of Europe.

There are a few trees about which there is controversy as to whether they are British or introduced by the Romans. However, one of our very definite natives is *Taxus baccata*, which is undoubtedly the most widespread of all yews and in fact must be among the most widely distributed trees of the temperate regions of the world.

Apart from the yew, we have only two other members of the conifer family. *Juniperus communis* in varying forms extends through Europe to the cooler temperate regions of the Far East and also into Canada. Our only cone-bearing native is *Pinus sylvestris*, the "Scots Pine" which also extends through Europe and in diverse forms to the Near East.

In the British Isles, the yew is usually found on calcareous soils and reaches its maximum size on rich, deep, well-drained loam over chalk, and although favoring shaded sites is tolerant of full sun. In making this comment, I am aware that yews may be grown successfully on almost every type of fertile soil. In this respect, the yew differs from our native holly *Ilex aquifolium* which, although lime tolerant, is generally found, and certainly reaches its greatest size, in damp acid soils.

There is evidence to prove that *Taxus baccata* was distributed through the forests of Western Europe including the British Isles in prehistoric times. In the Wood Museum at Kew, pieces of yew wood are preserved which were dug up from submerged forests in Yorkshire and Somersetshire. The yew is regarded as the patriarch of European trees.

The traditional use of the yew as an instrument of war and death in prehistoric times is evidenced by the discovery of yew spears, one found at Clacton being of great antiquity, and another in Lower Saxony being found between the ribs of the extinct straight-tusked elephant.

In spite of its good qualities, its popularity is a little surprising when one considers the poisonous qualities of its foliage and seed. There are many instances of cattle and horses being killed by browsing on yew. It is an established fact that yew branches which have been cut and left lying for a day or so are more poisonous than when fresh on the trees. It is strange that the attractive fleshy red seed cups are not poisonous and are readily devoured by birds and sometimes small boys. The hard seeds which contain the poison are discharged without disintegrating.

The wood of the yew is exceedingly hard and tough, and for that reason has been used for cogs for mills, as axles for cart wheels, and extensively by cabinet makers. Yew is one of the most durable woods known and posts placed in wet ground last longer than oak, of which the British Navy was originally built.

The great importance of yew wood was for bows and arrows, the bow being one of the principal weapons in ancient warfare. In the 14th and 15th centuries, the English archers were the most respected soldiers. Thus the yews of England became the arsenal and war machines of some hundreds of years ago.

Reference has been made to the difference in value between churchyard and woodland grown yews. In a table taken from the Ancient Laws of Wales, it states that a consecrated yew was worth a pound, while a wood or lay grown specimen was worth but 15 pence. In spite of this comment, the natural grown large woodland tree produced the national armory. Hence trees of this quality were of the greater value.

As I was writing these notes a little less than 3 weeks ago, a friend was browsing through the local paper in which was reported the sale of furniture in a nearby house. A Georgian 2 ft. 1 in. circular table made of yew wood sold for 290 lb. Sterling.

A recent book dealing with both ancient and modern archery describes a bow dug up in Cambridgeshire in 1855 from deep down in a bed of peat. It was impossible to discover its date, but the author considers it dated back to prehistoric times.

In more recent times, archery as a pastime was indulged in at one period almost to the exclusion of other sports.

It is stated that in 1387 Richard III, holding a Parliament in a temporary building on account of the wretched state of Westminster Hall, surrounded his hut with 4,000 Cheshire archers with tough yew bows to ensure freedom of debate.

There are no contemporary records of the origin of the churchyard yew, but circumstantial evidence is convincing that before the conversion of the South of Britain to Christianity, yews were sacred trees. It is recorded by Caesar that the adoption of the evergreen yew as a symbol of everlasting life was of Druidical origin. Druids, the priestly caste of the British Isles and Gaul in the days before Christianity, preached the doctrine of immortality. There is even evidence to support the theory that the yew was a sacred tree in Britain before Druidical times.

In an interesting little book by Dr. Vaughan Cornish entitled "The Churchyard Yew and Immortality," I have gleaned interesting information which describes how the history of the yew in the British Isles is intertwined with the history of England and the Church.

It seems probable that yews marked the sites previously used in connection with heathen worship and that Augustine and other Christian missionaries adopted these sites on which to erect our earliest churches. Thus the yews may well be older than the church. So the yews have witnessed such happenings as the departure of the Roman legions in 427, the coming of St. Patrick to Ireland in 432, the landing of St. Augustine at Kent in 597, the organization of hamlets or townships in a parish system A.D. 669, the so-called completion of the conversion of Saxon England A.D. 688, the loss of Normandy by England in 1204, the reformation of Scotland beginning in 1528, the suppression of monasteries in England in 1536, the expulsion of King James II and re-institution of Protestant monarchy in 1628.

When Fountains Abbey, Yorkshire, was founded for the Christian monks in 1132, there was no house until the Abbey was erected. It was stated that the priests had lived and worshiped beneath the shelter of the large yew trees, these being the famous Fountains Abbey yews of today.

Some writers are skeptical as to the age of some of our churchyard yews. In this connection, Miles Hadfield in his book Topiary and Ornamental Hedges writes, "The yew has an unusual feature in its growth. On ageing it throws up circumferential stems from the base which unite, the original trunk in time rotting and result-

ing in a hollow centre. It is thus impossible to make a ring count or obtain any wood from the centre to provide material for a radio-carbon estimate of its age".

There are hundreds of churches, especially in country areas, where the churchyard is dominated by one or more enormous and ancient yews. The large yew in the churchyard at Darley Dale is one of the most famous yews in England. It is estimated as being nearly 2,000 years old. The last reference I have of this tree is about 40 years ago when it was 50 ft. high with a girth of 32 ft. 4 in. at 4 ft from the ground.

Having undertaken to give this talk, I recently visited the churchyard at Salcombe Regis in Devonshire, where there stands a large and still vigorous and healthy yew. This parish was bestowed by a Saxon king upon the monks of Exeter which is regarded as a prehistoric place of assembly. In more recent times it has been the practice to construct family vaults beneath the yew which supports the prospect of immortal life.

Burying in the church itself was the early practice. About the year 750, those accustomed to attend the church service became entitled to burial in the enclosed space surrounding the church. However, centuries elapsed before the close clustering of the graves which we are now familiar in churchyards known in the early days as 'God's Acre'.

Some of the churchyard yews in England and Wales have interesting associations with characteristic customs of the people. Thus at Berkhamstead, Hertfordshire, parishoners were accustomed to assemble beneath the churchyard yew to welcome the coming of the New Year.

At Stockport, Cheshire, an annuity provided in 1684 for six old men was paid upon a stone beneath the churchyard yew.

At Painswick in Gloucestershire, where there are 99 yew trees in the churchyard, they are clipped on September 8, the Feast of the Nativity of Our Lady. On the following Sunday, locally known as 'Clipping Sunday', the parishoners, after morning service, march in procession around the churchyard and then join hands and form a ring around the church.

At Sedbergh in the West Riding of Yorkshire, the church which dates from late Norman times has yew trees in the churchyard beneath which George Fox (1624-1691), founder of the Society of Friends (Quakers), preached his doctrine.

At Brecknock, Thomas Evans Price prophesied that when the smallest yew tree in the churchyard grew as high as the belfry, the end of the world would come. The parishoners had faith in him and it became customary to lop off the upper branches of the yews to postpone the evil day!

In Ireland the yew tree is often called a Palm in view of its frequent use in the procession on Palm Sunday and Good Friday.

During the reformation of England, 1536, the question arose whether the procession of Palm Sunday should be regarded as devout or superstitious. Twelve years later, King Edward VI prohibited the blessing of Palms and their carrying in procession as superstitious observances.

There are circular churchyards associated with the quaint legend that there is no corner by which the devil could come in. At Brockenhurst, Hampshire, where the

church is upon a mound, the circular outline of the original churchyard can still be traced. This is decorated by a beautiful yew on the southwest side.

In 1656, the Rev. Collinson of Ashill, Somerset, stated that our forefathers were particularly careful in preserving churchyard yews which by reason of their perpetual verdure were emblematical of the immortality of the soul.

The very dubious honor of being the most ill-omened tree in Britain must be ascribed to the yew. The following lines from Lord Tennyson's "In Memoriam" put in poetic form the association of the yew with the graveyard:

"Old Yew, which graspest at the stones
That name the underlying dead,
Thy fibers net the dreamless head,
Thy roots are wrapt about the bones".

Shakespeare alludes to the yew in connection with the following lines in Twelfth Night, Act ii:

"My shroud of white, stuck all with Yew,
Oh' prepare it".

Prior refers to the distinguished appearance and evergreen character of the leaves:

"Why the changing Oak should shed,
The yearly honour of his stately head;
Whilst the distinguished Yew is ever seen,
Unchanged his branch and permanent his green".

Loudon quotes:

"The Yew is venomous when it is in flower because
the tree is then full of sap; and then its shade
is fatal to all who sleep under it".

Pliny states "the berries of the Yew are of a mortal poison; and that persons have died who have drunk wine out of casks made of the wood".

For those interested in large specimen yews, Mr. Alan Mitchell, Arboriculturalist to the Forestry Commission and author of a recent best seller, "Collins Field Guide to Trées", has kindly given me the following measurements which he has taken of churchyard and other yews:

Selborne in Hampshire	26'4" girth (reputed to be 1,000 years old)
South Hayling, Sussex	33'6" girth at 3'
Hambledon, Surrey	40' high x 31' girth
Tandridge, Surrey	33'4" girth (3 fused stems)
Crowhurst, Surrey	30'4" girth
Ulcombe, Kent	32'1" girth
Ulcombe, Kent	34'8" girth at 5'

Lamberhurst, Kent	45' x 9' diam. at 3' (3 fused stems) spread 51 yards
Lamberhurst, Kent	Irish Yew 30' x 21' spread
Tisbury, Wiltshire	35' x 31' girth
Wooland, Dorset	29' girth at 3'
Keffolds, Surrey	48' x 29' girth
Loose, Kent	45' x 30'10" girth
Mamhead, Devon	50' x 32'2" girth at 1'

Taller trees with better boles are growing in the following locations. Scotland claims the oldest *Taxus baccata* at Fortingale, Perthshire, reputed to be 2,000 years old.

Engs, Cornwall	75' x 9' girth
Orton, Huntingdonshire	66' x 9'7" girth
Mells, Somerset	64' x 14'2" girth
Lowther Castle, Cumbria	71' x 12'11" girth
Lowther Castle, Cumbria	71' x 10'10" girth
Shugborough, Staffordshire	55' (many semi-prostrate stems cover 480' in circumference)
Pencarrow, Cornwall	<i>Taxus baccata</i> 'Fastigiata' 51'
Taymouth Castle, Perth	<i>Taxus baccata</i> 'Fastigiata' 52'
Munches, Kirkcudbright	<i>Taxus baccata</i> 'Fastigiata' 54'
Orton, Huntingdonshire	<i>Taxus baccata</i> 'Adpressa' 30' x 3'7" girth (an original tree planted in 1840)
Westonbirt, Gloucestershire	<i>Taxus baccata</i> 'Adpressa' 33' high
Walcott Park, Shropshire	<i>Taxus baccata</i> 'Dovastoniana' 25' x 4' girth
Studley Castle, Worcestershire	<i>Taxus baccata</i> 'Dovastoniana' 41' x 3'3" girth
Bedgebury, Kent	<i>Taxus cuspidata</i> 15'
Bicton, Devon	<i>Taxus celebica</i> (chinensis) 15'

On the first occasion I visited the United States, which was in the mid-50's, I was struck by two primary differences between the small to medium gardens of our two countries. It is only recently that in our country we have been adopting the open planning which is so noticeable in even small American gardens, which means there is comparatively little use made of hedging plants. The other feature was due presumably to your longer, hotter summers, or the difference between our insular

climate and your continental climate. With us, where we want all the sunshine that is available, we would not plant large growing forest trees anywhere near the house. One other reason for this action is we are always concerned with the roots undermining the stability of the building. In your country, in order to obtain protection from the hottest sun, I notice that you plant forest trees very close to your buildings.

To an Englishman, certainly of the older school, the actual experience of being in a garden is the feeling of privacy and protection from the bustle of the outside world. One enjoys the peacefulness and shelter which in no small measure can be brought about by walls or hedges. An Englishman's home is his castle.

Our larger gardens built in the days of extreme wealth are now passing out of private ownership to that of the National Trust. If one visits gardens of this period, for some acres around the house would be a formal or semi-formal garden in keeping with the architecture of the buildings. This would invariably be enclosed by splendid walls or hedges dominantly made of yew. Beyond this area one would step out into the pleasure gardens and parklands dotted with individual trees or groups of trees. During the last 250 years there was nearly always an area known as the American Garden. Although this did not have exclusively American plants, nevertheless in the main these gardens were of plants from the New World.

Since the beginning of this century, a new feature has been the introduction of a vast range of woody and herbaceous plants from China and the Far East.

The formal yew hedges are a product of garden craftsmanship which has been practically lost. The planter and maker of the yew hedges used almost as many precision tools as the builder who constructed the mansion. The care and attention lavished upon the making of a new yew hedge was perhaps greater than that bestowed on a newly constructed wall. Whereas the wall was built according to its size in the course of months or a few years, the yew hedge was the life work of two generations or more.

The nurseryman grew nicely trimmed bushes or pyramidal shaped trees which were regularly pruned and transplanted until delivery to the purchaser, by which time the trees would probably be between 4 and 8 ft. high and 2 to 2-1/2 ft. wide. These solid pyramidal plants would be positioned at 2-1/2 to 3 ft. intervals, normally in a single line.

It is a mistake to regard yews as slow growing. When well planted, fed, and cultivated, the established yew will, in a favorable season, increase at the rate of 15 to 21 in. a year. However, this annual growth would be reduced certainly by a half as a result of clipping, an operation which would be carried out once or occasionally twice a year. The last trimming is completed by not later than about the third week of August to ensure that there is time for the wound to heal and for the hedge to put on a growth of about one-half in. before winter. In order to achieve uniformity in growth and color of unfolding leaves, it is necessary to propagate by cuttings from one or two selected clones. In a favorable season, the end of March to the middle of April is regarded as an excellent time to plant. In light, acutely drained soils, however, such plantings would suffer in the event of a dry summer. For that reason, gardeners on a light soil would more normally plant in early autumn as soon as we have sufficient rain between the middle of September and the end of October.

In hedge clipping, the essential to be observed is to have the greatest thickness at ground level, gradually reducing towards the top. This sloping face is known as "the batter" of the hedge and it is normal to have an inch batter to a foot in

height. To attain this, the gardener has a tool formed of an erect post to the required height secured to which is a subsidiary post held rigidly at the correct batter. The alignment of the hedge is meticulously measured, using a straight edge and spirit-level in the same manner as a builder would use when erecting a wall.

Yews have been shaped in almost every conceivable form, some in the shape of animals, birds or some architectural feature such as circles, arches, domes, globular shapes, spiral shapes, and so forth. To achieve these, a gardener constructs a wire framework to which the young primary branches are secured.

The modern nurseryman has no conception of the vast amount of time and training given by skilled men to produce in the nurseries the foundation specimens which are used for creating these formal and semi-formal gardens. Perhaps the other comparable crop would be the very carefully trained fruit trees used for walls and other positions in the kitchen garden, or the ornamental fruit garden with which might be associated herbaceous borders. The normal time would be 4 to 10 years to train an espalier or fan-trained fruit tree. The French gardeners were past masters at cultivating and training espalier, fan, and cordon trees.

I cannot think of this subject without my mind going back to the occasion when as a small schoolboy I reared canaries, and in an effort to make a little pocket money I would from time to time have a canary to offer for sale. On one occasion I inserted an advertisement in our local paper, the "Hampshire Chronicle," advertising an attractive canary. A lady responded by writing and asking further details about the bird. My father, picking up the letter and not appreciating that he had a businesslike son, quoted well-clipped and trained yew bird shapes from 5 to 20 years old, well-balled specimens weighing from 2-1/2 cwt. to 10 cwt. at from 5 to 25 lb. Sterling each. The good lady replied that she thought there had somehow been a little mistake.

Historically the making of topiary specimens and formal hedges appears to have commenced in Roman times in Italy. The art has been practiced in Holland, but in the last 500 to 800 years it is British and French gardens which have brought the practice to a fine art.

I have one or two slides to show you but these will do no more than I hope whet your appetite to come and see some of our formal English gardens if you have not already done so.

I am indebted to the Duchess of Abercorn and her son, Lord Hamilton, for going to considerable effort to take and send me slides of the original Irish Yew.

The slides showing hedging and topiary have been very kindly loaned to me by Mr. Graham Thomas, garden adviser to the National Trust.

For the remainder I must thank Mr. Roy Lancaster, our Curator, for slides taken in our own arboretum and at Bedgebury which is the national collection of conifers, quite a few of which were supplied by us precisely 50 years ago and since.

If I remember correctly, I believe we sent a small collection of *Taxus* to Dr. Chadwick in the mid-30's. Maybe in my wandering I shall meet a few old friends.

APPENDIX

JAPANESE YEW (TAXUS CUSPIDATA)

Dr. Makoto Kawase
Professor of Horticulture
Ohio Agricultural Research and Development Center

Japanese yew is the most important foreign evergreen ever introduced to this country. The rich, dark green foliage, which does not change even in winter season, is one of its great assets. Japanese yew is hardy enough to be grown in the areas designated as hardiness zone IV in Canada and the U.S., including southern parts of Maine, New Hampshire, Vermont, New York, and Michigan. Many horticultural varieties have been selected for their shape and size. Hardiness is introduced into Anglo-Japanese yews by hybridizing English and Japanese yews. According to Donald Wyman, George R. Hall, a medical doctor, first introduced this species into the United States in 1861.

Japanese yew is native in Japan, Korea, Manchuria, and Sakhalin Island. There is a possibility that some ecotype hardier than those varieties presently available in the U.S. could be obtained from Manchuria and Sakhalin Island.

Japanese yew is grown on four Japanese islands--Hokkaido, Honshu, Shikoku, and Kyushu. Native vegetation is now limited to the deep mountains of middle to northern Japan. It sometimes reaches a size of 20 meters high and 0.7 meter in diameter. Although its cultivation is not too extensive, Japanese yew is used for landscape planting and as hedges in Japan. Its lumber is used for building material and making tools.

Ichii, the Japanese name for *Taxus cuspidata*, means something like "the first rank in the imperial court house." Such a name was likely given to this species because scepters were often made from this wood in old days. Scepters are now only used by Japanese royal families for their traditional ceremony at the imperial court and by Shinto ministers for their religious services.

There is one subspecies of *Taxus cuspidata* in Japan, var. *umbraculifera* Makino. This species is also used as an ornamental by many Japanese. One is still able to find it growing as natural vegetation on higher mountains in Honshu, such as Dai-sen (Tottori Prefecture) and Hyono-sen (Hyogo Prefecture). It is a spreading type of yew and its height easily reaches 1 meter but rarely 2 meters.

FERTILIZING TAXUS FOR OPTIMUM GROWTH

Elton M. Smith
Extension Specialist, Landscape Horticulture
The Ohio State University and
Ohio Agricultural Research and Development Center

Optimum growth of *Taxus*, like all other plants, is dependent on the right combination of cultural practices, environmental factors, and soil conditions. An adequate amount of fertilizer in the soil is one of the practices which helps to assure the production of healthy, vigorous plants in the shortest possible time.

To ascertain the amount of fertilizer necessary to produce optimum growth of *Taxus* in lining-out beds and the nursery, studies have been conducted in cooperation with commercial nurseries during the past several years in Ohio.

The rates of fertilizer ranged from 0 to 8 to 10 lb. of actual nitrogen per 1,000 sq. ft. per yr. The phosphorus and potassium were brought to a satisfactory level, according to soil tests, prior to adding or were applied with the nitrogen. Typically, the fertilizer was applied with a rotary granular distributor. The *Taxus* were evaluated by harvesting at the soil line and weighing, rather than measuring height or width, which is less accurate.

The data in Table 1 indicate that 5-6 lb. of actual nitrogen per 1,000 sq. ft. in the form of urea resulted in optimum growth of 2-year-old *Taxus media* '#8' when grown in a silt loam soil. The plants were fertilized in late March 1973 and were evaluated in early October the same year.

TABLE 1.--Effect of Nitrogen on the Growth of *Taxus* in Lining-out Beds After One Growing Season in Silt Loam Soil.*

Treatment Lb. N/1,000 sq. ft.	<i>Taxus media</i> #8 Growth in Dry Weight (grams)
0	2.1
2	2.3
3	2.5
4	3.3
5	3.9
6	3.6
7	3.3
8	3.1

*The data are expressed as dry weight in grams, with each figure representing an average of five plants per treatment.

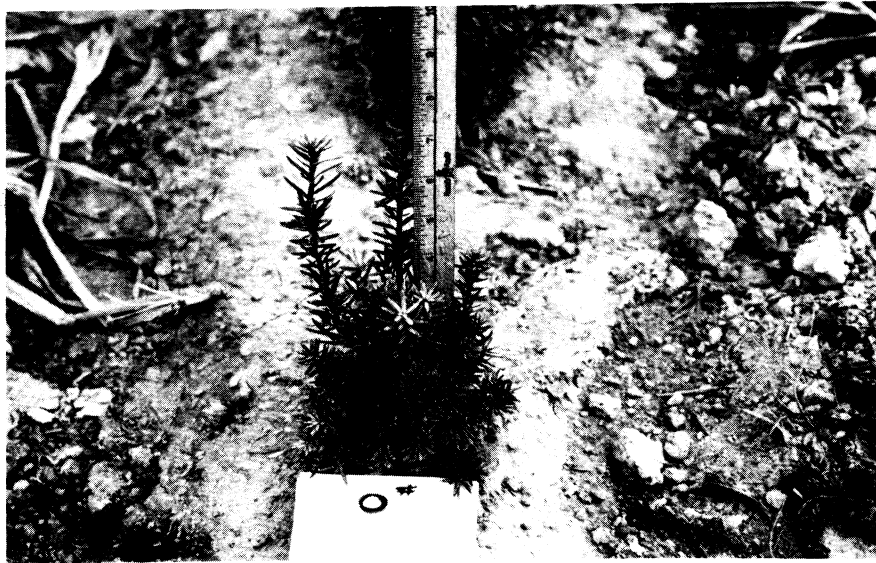


FIG. 1.--Unfertilized control of Taxus media 'Densiformis' following two growing seasons.



FIG. 2.--Two lb. each of actual nitrogen, phosphorus, and potassium applied for 2 consecutive years on Taxus media 'Densiformis'.



FIG. 3.--Five pounds each of actual nitrogen, phosphorus, and potassium applied for 2 consecutive years on Taxus media 'Densiformis'.

Four-year-old field-planted *Taxus media* 'Densiformis' were fertilized with 16-16-16 in December 1971 and again the following winter in early January 1973. The plants were evaluated by harvesting at the soil line in October 1973.

As shown in Table 2, the optimum growth of *Taxus* occurred at the rate of 5 lb. of actual nitrogen, phosphorus, and potassium per 1,000 sq. ft. The next best treatment occurred at the 4 lb. rate.

In both studies, but particularly in the field study, high rates of fertilizer were wasteful and quite likely harmful as well, since growth was sparse.

Based on this and other studies, The Ohio State University recommends for optimum growth of *Taxus* a foliar range of nitrogen of 2.00 to 2.20%, phosphorus of 0.30 to 0.35%, and potassium of 1.75 to 2.00%.

In summary, the conclusions of these two studies suggest that the range of 4 to 6 lb. of actual nitrogen per year results in optimum growth of *Taxus*. The rate of 5 lb. of N per 1,000 sq. ft. per yr. was the most satisfactory treatment for optimum growth of *Taxus media* '#8' in a lining-out bed and of field-planted *Taxus media* 'Densiformis'. Foliar values of nitrogen, phosphorus, and potassium are suggested for optimum growth. More research is needed with other cultivars under varying climatic conditions and soil types.

TABLE 2.--Effect of Varying Rates of 16-16-16 on Growth of *Taxus* Over a 2-Year Period.*

Treatment Actual N, P, K/1,000 sq. ft./yr.	<i>Taxus media</i> 'Densiformis' Fresh Weight (grams)
0	36
2	64
3	80
4	93
5	112
6	86
7	79
8	67
9	60
10	50

*The figures represent the fresh weight of an average of five plants per treatment.

TABLE 3.--Mineral Element Levels of Foliage of Taxus media 'Densiformis' After Production in Soil Treated with 5 Lb. of Actual N/1,000 Sq. Ft./Yr. for 2 Years.

Mineral Element	Foliage Values
Nitrogen	2.10%
Phosphorus	0.33%
Potassium	1.83%

*Figures represent an average of 50 plants per sample.

TAXUS INSECTS: PROBLEMS AND RESEARCH IN OHIO

David G. Nielsen
Assistant Professor of Entomology
Ohio Agricultural Research and Development Center

Yew, *Taxus* spp., is one of the most important nursery crops in the North Central and Northeastern United States. In Ohio alone, we estimate that 5 million *Taxus* with a wholesale value of \$20-30 million are now in production. This accounts for approximately 20% of Ohio's gross nursery sales. Total value of *Taxus* to nurserymen in the U. S. is difficult to assess; value in the landscape is impossible to estimate. No other evergreen approaches its importance as a foundation and border woody plant.

Until the 1950's, *Taxus* was a minor component in nursery production and suffered little from degradation by insects. As *Taxus* production increased, three insects became limiting factors and created management problems in its production. Black vine weevil, *Otiorhynchus sulcatus* (Fabricius), grape mealybug, *Pseudococcus maritimus* (Ehrhorn), and Fletcher scale, *Lecanium fletcheri* Cockerell, are now common pests of *Taxus* from the time of propagation to the time when plants are large enough to sell. These same insects often create problems on *Taxus* in the landscape.

In 1973, the Woody Ornamentals Laboratory at the Ohio Agricultural Research and Development Center began studying the seasonal history and chemical control of black vine weevil. This most serious insect pest of *Taxus* and *Rhododendron* is the most difficult *Taxus* pest to control. The only insecticides available to control the weevil are the chlorinated hydrocarbons, most of which have been or will be banned for most nursery uses. In addition, we recently discovered black vine weevil resistance to dieldrin (Nielsen *et. al.*, 1975).

Soil insecticides proven effective against other subterranean beetle larvae and experimental materials were evaluated for control of black vine weevil larvae in an established *Taxus* planting in 1973 in northeastern Ohio. All materials were applied the second week of August after some larvae had hatched and moved down in the soil to begin feeding. Treatments and results of the study are presented in Table 1.

Although Furadan 10G was statistically superior to all other treatments, it did not provide the level of protection or control required by the nursery industry. We are repeating this work under similar conditions in a Pennsylvania nursery in 1975 to determine if earlier application will provide an acceptable level of larval control.

The recent actions by EPA in banning most uses of dieldrin and aldrin and suspension of chlordane and heptachlor apparently preclude future use of these materials as broadcast insecticides in the nursery. Our current emphasis, therefore, is to develop alternative control measures for larvae and adults by using insecticides believed to pose zero or minimal hazard to human health but providing a level of control acceptable to the nursery industry. Since we recently discovered black vine weevil adult resistance to dieldrin and expect that they would be cross-resistant to other chlorinated hydrocarbons, and since these materials have not provided adequate control of weevil larvae, I do not believe the nursery industry should encourage the EPA to maintain chlordane for use against black vine weevil. Rather, the nursery industry can profit by supporting research to develop alternative control measures for this and other nursery pests.

A mobile laboratory with living and research facilities has been established in Lake County, the major Taxus production area in the state. We plan to begin intensive studies of black vine weevil behavior and chemical control in the spring of 1976, using this laboratory as our base of operations.

In 1975, we began evaluating the effectiveness of insecticides for control of grape mealybug to assure the industry continued availability of the most effective and safest insecticides for use against this pest. Treatments and results of the study are presented in Table 2. Besides learning that complete control of this insect on tightly sheared Taxus is difficult, we discovered that Taxus may be more susceptible to phytotoxicity from pesticides than previously believed.

The objective of our Taxus insects research program is to provide growers, landscape managers, and homeowners with the necessary tools to grow and enjoy taxus free from harmful infestations of insect pests.

Reference Cited

Nielsen, D. G., H. D. Niemczyk, C. P. Balderston, and F. F. Purrington. 1975. Black Vine Weevil: Resistance to Dieldrin and Sensitivity to Organophosphate and Carbamate Insecticides. J. Econ. Entomol., 68:291-292.

TABLE 1.--Number of Black Vine Weevil Larvae in Soil Treated with Insecticides in Mid-August, 1973.

Insecticide	Lb. AI/ Acre	Mean No. of Larvae
Furadan 10 G	8	3.5
Baygon 5 G	5	10.3
Zectran 2E	2	10
Dieldrin 1.5 EC	5	15.8
Furadan 4 Flowable	8	12.5
Dasanit 15 G	10	13.8
Diazinon 14 G	6	16.8
Dyfonate 4 E	4	18.8
Dursban 2 E	2	24.8
SD-34110 10 G	5	28
Primicid 10 G	2	29
Check	--	12.5

TABLE 2.--Number of Living Grape Mealybugs on Taxus Foliage* Treated with Insecticides in Early June 1975 in Lake Co., Ohio.

Insecticide	Lb. AI/ 100 Gal. Water	Mean No. of Mealybugs
Phosvel 3 EC	3.6	0 [†]
Phosvel 3 EC	0.9	8.5
Zolone 3 EC	1	0
Zolone 3 EC	0.5	0.5
Zolone 25 WP	1	0.5
Zolone 25 WP	0.5	0.5
Zolone-Malathion 1.5 EC [‡]	0.75	1.3
Zolone-Malathion 1.5 EC	0.25	0.3
Sevimol 4	1	1.3
Lannate 2 EC	0.5	1.3
Lannate 2 EC	0.25	5.8
Imidan 1 E	0.5	2.5
PP 557 2 EC	1.5 oz.	28.8
PP 557 2 EC	0.75 oz.	26.5
Di-Syston 1 G	12 lb. AI/Acre	31.3
Temik 10 G	20 lb. AI/Acre	32.8
Dacamox 10 G	20 lb. AI/Acre	48.3
Orthene 1 G	10 lb. AI/Acre	86.8
Check		34.0

*Approximately 40 inches of new foliage (10 4-inch samples) were inspected per plant (replicate).

[†]All Phosvel and Zolone treatments caused unacceptable phytotoxicity (stunting, chlorosis, and necrosis).

[‡]Active ingredient of Zolone.

TAXUS LOCATIONS IN THE SECREST ARBORETUM

The majority of *Taxus* in the Secrest Arboretum are located in the *Taxus* Specimen Plots A30, A31, and A33. Older but limited plantings can be found in Plots B1, C1, and J37. Several hundred individual plants have also been outplanted around the OARDC campus.

Taxus are listed alphabetically, with plot locations indicating in which plot the plants may be found. Plants may be located two ways in each plot.

1. Locations within each plot are 12 feet by 12 feet. Each location has been assigned a number. The first list for each plot has the plants located alphabetically. Thus, *Taxus baccata* 'Nigra' is at location A30-194 (*i.e.*, numerical location 194 in Plot A30). Each plant has a sign with the name of the plant, location number, and date outplanted. A number in *italic* on the map indicates an open space in the plot.
2. A second plot listing is numerical and should aid in locating plants in the plot in relation to each other. If a sign should be missing, the plant can still be identified by measuring from the nearest plant having a sign to determine numerical plot location. A number with no name after it indicates an open space in the plot.

<i>Taxus baccata</i> 'Adpressa' -- A30	<i>Taxus hunnewelliana</i> 'Globosa' -- A31	<i>Taxus media</i> 'Hatfield #23' -- A30
<i>baccata</i> 'Aurea' -- A30, B1	<i>media</i> -- A31	<i>media</i> 'Henryi' -- A31
<i>baccata</i> 'Compacta' -- A30	<i>media</i> 'Amherst' -- A31	<i>media</i> 'Hetzi' -- A30
<i>baccata</i> 'Dovastoniana' -- A30	<i>media</i> 'Andorra' -- A30	<i>media</i> 'Hicksii' -- A30
<i>baccata</i> 'Erecta' -- A30	<i>media</i> 'Anthony Wayne' -- A31	<i>media</i> 'Hill' -- A30
<i>baccata</i> 'Expansa' -- A30	<i>media</i> 'Berryhill' -- A31	<i>media</i> 'Hoogendoorn' -- A30
<i>baccata</i> 'Fastigiata' -- B1	<i>media</i> 'Brevicata' -- A31	<i>media</i> 'Kelseyi' -- A30, A31
<i>baccata</i> 'Glauca' -- A30	<i>media</i> 'Broad Beauty' -- A30, A31	<i>media</i> 'Kobel' -- A31
<i>baccata</i> 'Michelii' -- A30, B3	<i>media</i> 'Brownhelm' -- A31	<i>media</i> 'L. C. Bobbink' -- A30
<i>baccata</i> 'Nigra' -- A30, A31	<i>media</i> 'Brownii' -- A31	<i>media</i> 'Lodi' -- A31
<i>baccata</i> 'Overeynderi' -- A31, B1	<i>media</i> 'Burr' -- A30	<i>media</i> 'Midget' -- A30
<i>baccata</i> 'Repandens' -- A30, B1	<i>media</i> 'Chadwick' -- A31	<i>media</i> 'Mitiska Upright' -- A31
<i>baccata</i> 'Washingtonii' -- B1	<i>media</i> 'Coleana' -- A30	<i>media</i> 'Moon' -- A31
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