

**HUMANITY IN HUMANS, BY HUMANS  
AND FOR HUMANS  
IN SECURING FOOD FOR ALL**

**The Basics of Human Civilization – Food,  
Agriculture and Humanity**

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## The Human Connection to Horticulture

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### SYNOPSIS

**H**orticulture is intimately connected to humankind in various critical and essential ways—through provision of essential minerals and nutrients in diets, the use of ornamental and amenity plants to enhance leisure and pleasure pursuits, providing livelihoods and advancing culture through the use of horticultural subjects in art and literature. Horticulture also enhances the environment, especially in major urban centers where trees, shrubs and ornamental plantings in parks, roadside avenues and rooftop gardens can provide shade and shelter, reduce the impacts of heat islands caused by buildings, roads and infrastructure, and even enhance road safety and the security of residents. The presence of and interaction with green spaces has also been shown to enhance physical and mental well-being, and the rate of recovery of patients in health care. Horticulture truly feeds us, sustains and cures us, and makes life worth living. It provides food for body and soul.

**Keywords:** fruit, vegetables, ornamentals, spices, human health, art, literature, human well-being

### 1. Introduction

Horticulture, narrowly defined refers to the cultivation of garden plants. However, horticulture is multidimensional and covers huge areas of human interest and activity. First, it has an ancient tradition and its techniques can be considered to be basic to the very origin of agriculture in the Neolithic and the Bronze Ages. Thus horticulture can be considered the 'Mother of Science'. Horticulture now includes wider science components and is a scientific discipline in its own right. The human dimension of horticulture involves all peoples and cultures. It includes plants that provide sustenance in terms of food and nutrients; culinary herbs and spices that provide flavors that enrich our cuisine and delight our palate; medicines and nutrients that cure our ills, strengthen our bodies, and calm our disposition; fragrances that adorn our bodies, mask disagreeable odors,

and attract the opposite sex; wines that raise our spirits; turf, trees, and ornamental plants that light our tread and shade us from the sun, and provide beauty to our landscape. Plants are an integral part of our lives and horticulture is concerned with human amelioration of the environment through gardens, landscapes, and playing fields. Because of these special attributes, horticulture has been incorporated in the visual arts, songs, poetry, and literature besides becoming integrated in religious practices of all faiths.

## 2. Sustenance and Culinary Delight

Although grain crops, such as, wheat, rice, sorghum, and maize are principle suppliers of calories, horticultural crops are prized for their flavors, nutrients, minerals, and phytochemical contents, such as, vitamins, polyphenols, terpenoids, organo-sulphurs and alkaloids (Desjardins, 2014). Horticultural crops, principally legumes, are important sources of protein, while fruits and tuber crops are rich sources of carbohydrates, vitamins and fiber, and leafy vegetables are an important source of minerals, nutraceuticals and vitamins; some fruits, such as, olive and avocado are sources of lipids (Tables 1 and 2). The advantage of diets rich in plant over animal sources is production efficiency since animals must be fed on crops that could feed humans. For example, it has been calculated that it takes about 15,000 liters of water to produce a kilogram of animal protein (dry weight) as compared to about 240 liters for an equivalent weight of lettuce, or 125 liters for a 150 g apple or for one glass of wine (Mekonnen and Hoekstra, 2010; 2011). Consequently, a shift to a horticultural rich diet may be essential to feed the planet as world population continues to increase. At current estimates, the population of the world (current population, 7 billion) is expected to be 9 billion by 2050 (a 30 % increase) and perhaps 11 billion by 2100 (a 60 % increase) (<http://www.worldometers.info/world-population/>).

**Table 1.** Nutritive value per 100 g of selected fruits, vegetables and nuts (Source: USDA National nutrient data base).

Selected crops	Total	Protein (g)	Dietary fibre (g)	Fat (g)	Sodium (mg)	Potassium (mg)	Calcium (mg)	Vitamin A (IU)	Vitamin C (mg)
	carbohydrate (g)								
Apple	13.8	0.26	2.4	0.17	1.0	107	6	54	4.6
Avocado	8.5	2.00	6.7	14.66	7.0	485	12	146	10.0
Banana	22.8	1.09	2.6	0.33	1.0	358	5	64	8.7
Durian	27.1	1.47	3.8	5.33	2.0	436	6	44	19.7
Grape	18.0	0.72	0.9	0.16	0.0	191	10	66	10.8
Guava	14.3	2.55	5.4	0.95	2.0	417	18	624	228.0
Kiwifruit	14.7	1.00	3.0	0.52	3.0	312	34	87	92.7
Mango	17.0	0.50	1.8	0.27	2.0	156	10	765	27.7

Table 1. contd.

Selected crops	Total carbohydrate (g)	Protein (g)	Dietary fibre (g)	Fat (g)	Sodium (mg)	Potassium (mg)	Calcium (mg)	Vitamin A (IU)	Vitamin C (mg)
Muskmelon	8.6	0.84	0.9	0.19	1.0	267	9	3382	36.7
Orange	11.8	0.94	2.4	0.12	0.0	169	40	225	53.2
Peach	9.5	0.91	1.5	0.25	0.0	190	6	326	6.6
Pear	13.8	0.38	3.1	0.12	1.0	119	9	23	4.2
Pineapple	13.5	0.54	1.4	0.12	1.0	109	13	58	47.8
Sapodilla	19.9	0.44	5.3	1.10	12.0	193	21	60	14.7
Strawberry	7.7	0.67	2.0	0.30	1.0	153	16	12	58.8
Sweet cherry	16.1	1.06	2.1	0.20	0.0	222	13	640	7.0
Watermelon	7.6	0.60	0.4	0.15	1.0	112	7	569	8.1
Vegetables									
Asparagus	3.4	2.20	2.1	0.12	2.0	202	24	756	5.6
Broccoli	6.6	2.80	2.6	0.37	33.0	316	47	623	89.2
Cabbage	5.8	1.30	2.5	0.10	18.0	170	40	98	36.6
Carrot	9.6	0.93	2.8	0.24	69.0	320	33	16706	5.9
Cassava	38.1	1.36	1.8	0.28	14.0	271	16	13	20.6
Cauliflower	5.0	1.52	2.0	0.28	30.0	200	22	0	48.2
Cucumber	3.6	0.65	0.5	0.11	2.0	147	16	105	2.8
Eggplant	5.7	1.00	3.4	0.19	2.0	230	9	27	2.2
Fava bean (raw)	58.6	26.12	25.0	1.53	13.0	1062	103	53	1.4
Green beans	7.1	1.82	3.4	0.34	6.0	209	37	690	16.3
Leaf lettuce	2.8	1.36	1.3	0.15	28.0	194	36	7405	9.2
Lima bean (raw, mature)	63.4	21.46	19.0	0.69	18.0	1724	81	0	0.0
Onion	9.3	1.10	1.7	0.10	4.0	146	23	2	7.4
Potato	15.9	1.89	2.5	0.10	6.0	455	10	7	11.4
Radish	3.4	0.68	1.6	0.10	39.0	233	25	7	14.8
Sweetcorn	18.7	3.27	2.0	1.35	15.0	270	2	187	6.8
Winged bean	4.3	6.95	-	0.87	4.0	240	84	128	18.3
Nuts									
Cashew	30.2	18.20	3.3	43.85	12.0	660	37	0	0.5
Peanut	16.1	25.80	8.5	49.24	18.0	705	92	0	0.0

**Table 2.** Sources of essential nutrients and minerals for human health from a range of fruit and vegetables (modified from <http://www.5aday.co.nz/media/36377/5plus-a-day-in-colour.pdf>).

Nutrients	Purported functions	Vegetables	Fruits
Carotenoids	<ul style="list-style-type: none"> <li>● Some are converted into Vitamin A in the body</li> <li>● Stimulates the growth of new cells and keeps them healthy</li> <li>● Important as antioxidant or free radical fighters</li> </ul>	<ul style="list-style-type: none"> <li>● Orange, yellow and green coloured vegetables (e.g. pumpkin, carrots, kumara, spinach, parsley, sweet corn, broccoli)</li> <li>● Some red vegetables (e.g. red peppers, tomatoes)</li> </ul>	<ul style="list-style-type: none"> <li>● Yellow and orange fruit especially apricot, peach, nectarine, paw-paw, mango</li> </ul>
Vitamin B group	<ul style="list-style-type: none"> <li>● Releases energy from food</li> <li>● Promotes a healthy nervous system</li> </ul>	<ul style="list-style-type: none"> <li>● Green vegetables</li> </ul>	<ul style="list-style-type: none"> <li>● Avocado</li> </ul>
Folic Acid	<ul style="list-style-type: none"> <li>● Important for healthy growth and development. Especially during periods of rapid growth, e.g. pregnancy</li> <li>● Prevents neural tube defects</li> </ul>	<ul style="list-style-type: none"> <li>● Green vegetables</li> </ul>	<ul style="list-style-type: none"> <li>● Citrus fruit, banana</li> </ul>
Vitamin C	<ul style="list-style-type: none"> <li>● Fights against infection and is used in tissue repair and general health</li> <li>● Helps the body absorb iron from food</li> </ul>	<ul style="list-style-type: none"> <li>● Excellent: red, green pepper and parsley</li> <li>● Very good: Brussels sprouts, broccoli, cabbage, spinach, cauliflower and radish</li> <li>● Good: leek, lettuce, spring onion, kumara, tomato, turnip, peas, bean, asparagus and potato</li> </ul>	<ul style="list-style-type: none"> <li>● Most fruit especially citrus fruit, blackcurrant, kiwifruit, pawpaw and mango</li> </ul>
Vitamin K	<ul style="list-style-type: none"> <li>● For clotting of the blood</li> </ul>	<ul style="list-style-type: none"> <li>● Leafy green vegetables, turnip, broccoli, lettuce, cabbage, spinach, asparagus, watercress, peas and beans</li> </ul>	<ul style="list-style-type: none"> <li>● Nil</li> </ul>
Calcium	<ul style="list-style-type: none"> <li>● Essential for healthy teeth and bones</li> </ul>	<ul style="list-style-type: none"> <li>● Spinach, parsley, broccoli, celery, leek, spring onion, cabbage, turnip and carrot</li> </ul>	<ul style="list-style-type: none"> <li>● Rhubarb, blackcurrant, blackberry</li> </ul>

**Table 2.** contd.,

Nutrients	Purported functions	Vegetables	Fruits
Iron	<ul style="list-style-type: none"> <li>● An important part of red blood cells. Helps carry oxygen around the body*</li> <li>● Extremely important for brain function and learning</li> </ul>	<ul style="list-style-type: none"> <li>● Spinach, silverbeet, parsley, leek</li> </ul>	<ul style="list-style-type: none"> <li>● Avocado</li> </ul>
Potassium	<ul style="list-style-type: none"> <li>● Controls the working of muscles and nerves</li> <li>● Essential component of every cell</li> </ul>	<ul style="list-style-type: none"> <li>● All vegetables</li> </ul>	<ul style="list-style-type: none"> <li>● All fruit especially avocado, banana, blackcurrant</li> </ul>
Fibre	<ul style="list-style-type: none"> <li>● Maintains a healthy digestive system</li> <li>● Is important in control of weight</li> </ul>	<ul style="list-style-type: none"> <li>● All vegetables</li> </ul>	<ul style="list-style-type: none"> <li>● All fruit</li> </ul>

\*Absorption of iron is increased when fruit and vegetables containing iron are consumed at the same time as vitamin C rich foods.

The production and marketing of culinary herbs and spices are specialized aspects of horticulture. In all areas of the world, cuisine is influenced by specific spices that provide special flavor and piquancy to foods. Especially important are black pepper (*Piper nigrum* L.) and red pepper (*Capsicum annuum* L.), cinnamon (*Cinnamomum* spp.), mint (*Mentha* spp.), ginger (*Zingiber officinale*), and nutmeg (*Myristica fragrans*). At one time these spices were so important that they drove the global economy and the richest countries were those that controlled their production and transfer. In fact the 'Age of Discovery' was incited by a need of Europeans to find a cheaper route to the spice-rich East. The great travelers and explorers (Marco Polo, Columbus, Vasco da Gama and Magellan) were obsessed with finding a sea route to spice-rich India and south Asia since the land routes were controlled by the Islamic world and the Venetian traders. Spices no longer hold an economic grip on the world, but continue to be an integral part of many cuisines.

### 3. Horticulture and Health

The relationship between horticulture and health has been and continues to be of great concern for humankind (Janick and Hummer, 2010). There are two issues involved: diet and medicinal uses of plants and plant products. Plant cures and nutrition were long a part of ancient medicine systems including those of Sumer, Babylonia, and Greece, and remain important within societies in China, and India. Each developed a strong nexus of health with plant-derived medicines.

In fact most of our common vegetables were originally medicinal plants. Health and well-being were long rationally based on nutrition and promoted by the consumption of vegetables, fruits, and herbs (Table 2). Plants are complex biochemical factories which have been exploited as medicines in the proper dosages and formulations. Some are so potent that their misuse has become the dark side of horticulture. These include human scourges, such as, heroin from opium poppy, tobacco, ghat, marijuana and peyote. It is intriguing that, up to the present, most of our medicines were originally plant derived (aspirin, for example) although at present efficacious molecules have been identified, permuted, and altered by the modern pharmaceutical industry.

Plants as medicine has an ancient tradition. A Sumerian text from 2100 BCE mentions plant sources; the Edwin Smith Papyrus (1800 BCE) mentions the prevention and cure of infection using honey and bread mold; the *Ebers Papyrus* includes 700 formulae and remedies most of which involved plants such as opium poppy. Greek medicine had a strong connection with herbal medicine led by root diggers called *rhizotomoi*. The word for drug merchants, *pharmacopuloia*, was derived from the Greek word for remedy or drug and gave rise to the modern word pharmacy. Hippocrates, now considered the Father of Medicine, mentions almost 400 medicinal herbs. The school of Hippocrates (400 to 377 BCE) stressed that diet influences health and recommends moderation. In the East the two great medical traditions, Chinese and Indian, incorporated plants as medicines. The Indian system known as Ayurveda medicine was rich in plant cures. Both Western and Indian medicine relied on the concept of health being a balance of humors (4 in the West: and 5 in the East) which suggests a common tradition.

The herbal tradition in the West dates back two millennia. The Greek herbal written by Pedanius Dioscorides of Anazarba (translated as *De Materia Medica* in Latin and *On Medical Matters* in English) in the year 65 defined the health-giving properties of over 500 plants. In 512 the manuscript was illustrated as a result of Arabic translations and became one of the most famous books ever written. It was slavishly referred to, copied, and commented on for 1500 years. The epoch of printing in Europe made herbals the basic source book of physicians and the current interest in herbal medicine still persists (see, for example, Inoue and Craker, 2014).

The relationship between horticulture and health at present is based on modern science: nutritional studies along with pharmacology and medicine. It first became influential when it was discovered that the dreaded consequences of scurvy, long a scourge of seamen in the Age of Discovery, could be ameliorated with the consumption of citrus fruits or sauerkraut. It was demonstrated that scurvy

was due to a lack of L-ascorbic acid (Vitamin C). The subsequent identification of various vitamins (the term is derived from vital amines) had a great effect on the popular conception of the healthfulness of fruits and vegetables. In recent years, various constituents in fruits and vegetables including antioxidants, carotenoids, flavonoids, glucosinolates, polyphenols, polysaccharides, organic acids and lipids (Desjardins, 2014) have been demonstrated to be protective agents against certain diseases including cancer. The concept of functional foods has been established and the benefits are under intense study but are still not clearly understood or established.

It is clear that the present day emphasis on the connection between horticulture and health is an extension of ancient and medieval concern. We suggest that our present understanding of nutrition will probably be considered naïve in the coming centuries and in the future the approach of attributing health benefits to horticultural crops may likely be very different from the present one. We predict, however, that the conclusion will be similar: horticulture crops are essential to good health.

The interest in diet and health are pervasive in all our cultures. This has led to the strong modern interest in proper diets for health. The subject is complex and confusing. The present general consensus is that moderation is essential and that diets need to be rich in fruits and vegetables (Table 2). Some for various reasons have shifted to avoidance of animal protein and products (vegan diets), while others, so called vegetarians, will incorporate some animal products such as eggs and dairy and perhaps fish. Some ancient indigenous cultures in the north (Eskimos and Inuits) had persisted on diets almost completely based on seafood without any vegetables which is counter intuitive. At present, the effect of high fats is controversial but nutritionists agree that trans fats are to be avoided. Recently, the over use of refined sugars have been implicated for many human ills including obesity and diabetes. Clearly a full understanding of human nutrition has much to accomplish but the consensus is that diets rich in horticultural products are healthy.

Horticulture also has its place in mental health, general well-being, and provides social benefits (Cameron, 2014). The beneficial activity of gardening derives from its value as a pleasant form of physical activity, along with promotion of social skills and exposure to nature and the natural environment which is inherently relaxing especially in the modern world. Horticultural therapy has become one of the various activities that has been found useful in hospitals and retirement communities. Some of the claims made in these areas remain controversial but evidence is increasing about the benefits that can be



achieved through exposure to activities such as gardening and to the impacts of "green space" on a range of psychological and physiological responses (Table 3). Clearly, flowers and plants lift the spirit, while gardens and green landscapes have been found to be restorative to the human psyche.

**Table 3.** Physiological, psychological and social benefits relating to human involvement with "green spaces", including parks, community gardens, green roofs, and trees and gardens on streets and in properties (modified from Lohr and Relf, 2014 and Cameron, 2014 – see also for detailed references relating to each attribute).

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### **Physiological benefits**

Improved cardiovascular-respiratory fitness

Reduced heart/pulse rate

Reduced respiratory illnesses

Relief from headaches

Reduced muscle tension

Enhanced physiological motor performance and maintenance of mobility

Longer telomere length (less oxidative damage to DNA)

Less stress (lower cortisol production)

Improved brain function

Diminished risk of osteoporosis, falls and fractures

Lower body mass indices

Fewer heat-related deaths

### **Psychological benefits**

Improved self-awareness and self-esteem

Reduction in negative feelings (e.g. anger, fear, anxiety, frustration)

Improved ability to recover from stressful events (such as breast cancer)

Effective alleviation of the symptoms of anxiety, depression and psychosomatic illnesses

Delays in the onset of dementia

### **Social benefits**

Enhanced personal and social communication skills

Increased independence

Increased sensitivity to one's own wellbeing

Reduced crime rates and enhanced rehabilitation rates

Enhanced real estate values

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#### 4. Horticulture and the Environment

The relationship of human beings to the environment has become a pressing issue in our society which is especially true as world populations become increasingly urbanized. In rural, nomadic, hunting and in agricultural societies there is a strong connection between humans and the natural landscape. This has been compromised in large cities that now feature strongly in modern society where concrete and steel dominate the landscape and the connection between humans and the surrounding natural landscape has largely been lost. Horticulture is one way for modern humans to bridge this gap; the green environment can be captured in the forms of gardens and landscapes, in parks and yards, in rooftop gardens, and in tree-filled city streets and thoroughfares. Thus modern urban planning has incorporated horticulture as an essential component in many cities – examples of such development include those occurring in major urban centers as diverse as Curitiba, Helsinki, Penang, Ulsan and Yokohama (Yusuf, 2013).

The impact that horticulture can have in the urban environment can be assessed in a number of different ways:

**Temperature:** The most obvious is the provision of shade and shelter. However, when considered over extensive areas within urban settings, such impacts can also ameliorate the “heat island” effects of large areas of buildings, roads and infrastructure and reduce cost of factors such as air-conditioning for buildings and even road wear. Temperature differences between planted areas and open urban spaces can vary markedly depending on the area of planted vegetation, location (latitude), air movement, cloudiness and many other factors; however, differences of up to 10°C can be determined (Kim, 1992). These factors may become even more significant when climate change predictions are realized. Shaded walkways can also encourage citizens to walk and access to urban parks can encourage people to exercise. Horticultural plantings of highways and urban roads can also reduce road accidents through their calming effects on drivers. Such green spaces, like the provision of parks and gardens in urban areas, can markedly enhance the quality of life for residents (Lohr and Relf, 2014).

**Air quality:** Trees, especially when grown in large areas, can have an impact in ameliorating air pollution through intercepting particulate matter, reducing carbon dioxide concentrations and lowering the concentrations of other compounds such as ozone.

**Water quality:** All cities have to deal with major run-off from extensive built-up areas. This water is often loaded with sediments and can become polluted.

Pollution can be considerable if the built-up areas are extensive. Planted areas can filter sediments and chemical pollutants from such areas and reduce the velocity of water flow, thereby reducing potential erosion. Retained water can be used for a range of production, amenity and recreational uses (Lohr and Relf, 2014).

However, not all of the impacts of horticulture are positive on the environment and this fact must be faced. Within cities, plantings of trees, in particular, must take into account their potential interference with both underground (roots) and over-head (branches) services. Considerable costs can be associated with tree training and pruning.

The largest negative impacts, however, can occur in rural environments where a number of factors can be involved:

**Land use and soil quality:** Intensive horticultural production, if mismanaged, can lead to the degradation of soil structure through the loss of organic matter, increased compaction, erosion, reduction in fertility and loss of biodiversity (Lillywhite, 2014). These factors are often enhanced with monoculture and multiple cropping. However, good land management practices and crop rotations can reduce such impacts.

**Water:** Most horticultural crops are irrigated and can become one of the highest users of water per unit land area, even though the areas involved can often be relatively small within wider land users. Some sources of such water, including rivers, lakes and subterranean aquifers can become depleted if irrigation demands are excessive, besides such sources becoming polluted if runoff is excessive. Proper management practices can eliminate or minimize such impacts, if properly implemented. The use of hydroponics where water is recycled, drip irrigation and plastic films can minimize water usage in horticultural crops.

**Pesticide residues:** The use of pesticides is now more highly regulated than in the past. Nonetheless, the expectations of consumers for perfect, unblemished produce puts massive demands on producers that can result in high pesticide use. In some countries, the use of pesticides on unapproved crops, the use of illegal pesticides and the uncontrolled application of some products can all lead to unwanted residues on produce and negative effects to human health, environment and to soil health (Lillywhite, 2014). Fortunately, pesticide residue testing in most developed markets readily identifies such problems. The use of genetic resistance can greatly reduce use of pesticides. In integrated pest management (IPM) approaches and in controlled environments, insecticides can largely be eliminated by the use of natural predators.

**Invasive plants and lack of biodiversity:** A few exotic plants that have been introduced into some urban environments can lead to major problems in both rural and urban environments (Lohr and Relf, 2014). Examples of ornamental plants with these characteristics include the common heather (*Calluna vulgaris*) which has encroached into National Park areas in New Zealand, *Lantana spp.* which are a problem in many countries, and kudzu (*Pueraria spp.*) which is particularly a problem in the southern USA. It is critical that exotic ornamentals be checked for invasiveness before introduction if at all possible. In contrast, the lack of biodiversity within many ornamental species can become an issue with regard to susceptibility to pests and diseases especially in urban areas. A well-known example is Dutch elm disease (*Ophiostoma ulmi*) which decimated wide areas of plantings simply because of the limited biodiversity in the elm populations that were originally planted (Wilson, 1975).

## 5. Horticulture and Art

Horticulture is unique among the agricultural disciplines as there is an aesthetic dimension that involves human interaction and sensibility (Janick, 2014). This involves the direct appreciation of horticultural plants alone or collectively as pleasing visual objects, *i.e.* art in horticulture; and includes the wider use of horticulture objects and subjects as basic components of artistic expression in art forms as varied as drawing and painting, sculpture, mosaics, photography and tapestry, *i.e.* horticulture in art.

### 5.1. Art in Horticulture

Horticulture and art are intimately entwined. Most plants have an inherent capacity to visually stimulate us and most are considered as beautiful objects in themselves. It is, therefore, to be expected that some horticultural plants become motifs for artistic expression to adorn the table, the home, and as principle objects in the canvas of the landscape. This is based in no small part on our emotional attitudes toward them, since plants, flowers and fruits are universally admired. Feared objects such as snakes or spiders are often thought of as being ugly despite having many attributes we ascribe to beautiful objects. Many plants have an inherent capacity to visually stimulate our senses. The most obvious is their coloring, not only the brilliant hues of many flowers, fruits and leaves, but the muted tones of trees and bark. Green of course is the most common environmental color and our positive response is probably more than coincidental since it is also psychologically the most restful. The variety of colors in flowers and leaves is a source of continuous fascination.

Furthermore, the things that have been accepted as beautiful for long periods of time, and which are universally admired, have a basic simplicity and harmony of form and function. Furthermore, plants show symmetry, a common feature of plant growth which is inherently pleasing. Symmetry makes random shapes orderly. Plant form shows tremendous variation from turf and creeping ground covers, to shrubs, and trees of various sizes and shapes. Variety is more than the spice of life, it is the very essence and plants have evolved in a myriad of forms, shapes, and colors that appear continually interesting and fascinating.

The beauty we associate with individual plants and plants in groups and settings (gardens, landscapes, arrangements in containers, corsages) has been a dominant feature of ornamental or amenity horticulture. It has developed distinct professions such as landscape architecture and the floral arts – the arranging and design of ornamental plants. Differences between the two are a matter of scale. The arrangement of plants exploits two main types of association. One is formalism, a concept that originated in Egypt where the natural vegetation was scarce and arrangement of plants in gardens represented an artificial oasis where plants were arranged in symmetrical patterns. The formal arrangement represents the human dominance over nature. It emphasizes symmetry, severe pruning and training. In formalism, plants are arranged in an orderly, unnatural arrangement and represent an essential, artificial environment using plants as structural material.

Naturalism, an alternate concept, is an attempt to emulate the natural world. The concept of naturalism is to achieve the effect of being in a happy accident of nature to live with rather than dominate nature. Unlike the formal tradition, where plants are pruned to geometric shapes, the free form is emphasized and exaggerated in naturalism. Although the separation between gardens and landscape in formalism is clear-cut, in naturalism it is vague and indistinct. The landscape blends into the garden. The concept of naturalism originated in China and reached its highest development in Japan where there were beautiful natural landscapes to copy. Naturalism also developed independently in the West, specifically in England where the natural landscape – verdant meadows and rolling hills – were emulated. However, the methods to achieve naturalism are as artificial as those of formalism. Naturalism also involves training and pruning, and is combined with the wide use of many natural materials, such as, wood and stones. In the Eastern tradition, especially Japan and India, plants further assumed symbolic significance. Modern design promotes plants for people in a functional and pleasing way, combining both formal and natural arrangements.

## 5.2. Horticulture in art

Horticultural plants have been a major component of artistic expression from pre-antiquity to the present. Sources of plant iconography can be found in cave paintings, mosaics, sculpture, carving and inlays, frescos, tapestries, illuminated manuscripts, herbals, books and photographs. A special genre of art, from the Renaissance to the present, involves painting that stresses horticultural plants as the subjects - called "still life" (*nature morte*).

Works of art based on plants from prehistory to the present constitute an alternate source of information on plants and crops. Plant iconography becomes a valuable resource for investigations involving genetic and taxonomic information as well as crop history including evolution under domestication, crop dispersal and lost traits (Janick, 2014). Crop images are one of the unequivocal tools for assessing the historic presence of botanical taxa in a particular region and are a valuable resource for determining morphological changes of crops from antiquity to the present.

## 6. Horticulture and Literature

Horticulture is associated with a rich diversity of literature ranging from specialized scholarly books and articles devoted to the science and technology of horticulture, to include encyclopedias, textbooks, manuals, and specialized books on individual horticultural crops, as well as a myriad of gardening and cook books (Warrington and Janick, 2014). Furthermore, the intimate human connection with plants has provided a rich literature in novels, and poetry.

A number of very formal scientific journals are dedicated to the publication of scientific manuscripts that report on research discoveries in horticultural science. The Web of Science reports that there are 31 such journals within their assessment system (compared with 84 that cover the plant sciences). The most well-known journals in horticultural science are likely the *Journal of the American Society for Horticultural Science*, *Journal of Horticultural Science and Biotechnology*, *Postharvest Biology and Technology*, and *Scientia Horticulturae*. However, a wide range of other international journals are published covering many of the fields that are closely related to horticultural science, such as the *Annals of Botany*, *Journal of Plant Nutrition*, and *Journal of the Science of Food and Agriculture*.

Many specialist textbooks are available for the students of both horticulture and of horticultural science. Some of these are very extensive in their coverage (e.g. *Temperate-Zone Pomology. Physiology and Culture* by M.N. Westwood) while others are highly specific (e.g. *Quinoa – Botany, Production and Uses* by

A. Bhargava, and S. Srivastava, or *The Mango – Botany, Production and Uses*, edited by R. Litz.) More complete descriptions of such publications are covered in Warrington and Janick (2014).

A wealth of information that is relevant to horticultural production is contained in a large number of industry publications that are critical in advising producers of horticultural crops about the latest technical, scientific and product information that is available to them. These publications are usually sector-specific and are published either by grower organisations or by commercial companies that specialise in products such as seeds, agricultural chemicals or equipment. Examples of the former include *The Good Fruit Grower* and the *American Nursery Magazine* (USA), *The Orchardist* (New Zealand), and *The Vegetable Farmer* (UK).

However, the magazines with the widest distributions and highest circulation lists are undoubtedly those that are focused on subjects such as gardening and landscaping. For example, *The Garden* (Royal Horticultural Society, UK) has over 380,000 subscribers. There are a plethora of books and other publications that are devoted to specific ornamental and amenity crops including turf grasses.

Nowhere is the horticulture connection more prominent than in various religious books (Janick, 2013). The major religions of the world were developed by agricultural people in antiquity as a means of explaining the unknown, to seek answers to problems of every day existence, and to add solace and comfort to the problems of sickness, bereavement, and fear of death. Since most religions were developed in antiquity among primitive agricultural communities, there is a strong reference to horticultural plants and practices such as planting, grafting, training, harvest and processing that are interspersed in religious writings and have become aphorisms that are an important part of many cultures. Three examples involving grape vines follow:

*My well beloved had a vineyard in a very fruitful hill. And he fenced it and gathered out the stones thereof and planted it with the choicest vine and built a tower in the midst of it and also made a winepress therein: and he looked that it should bring forth grapes and it brought forth wild grapes. Isaiah 5.*

*I am the true vine and my Father is the husbandman. Every branch in me that beareth not fruit he taketh away and every branch that beareth fruit he purgeth it, that it may bring forth more fruit. John 15*

*And He it is Who produces gardens (of vines), trellised and untrellised and palms and seed-produce of which the fruits are of various sorts and olives and pomegranates, like and unlike; eat of its fruit when it bears fruit and pay the due of it on the day of its reaping and do not extravagantly; surely He does not love the extravagant. Qu'ran. The Cattle: 6; 141.*

## 7. Horticultural Plants as Symbols

As a result of the perceived value and importance of horticultural plants, they have become a source of inspiration integrated in our heritage and national identification. Consider the maple to Canadians, the leek to the Welch, the rose to the English, the palm tree to the Arabs, the cactus to Mexicans, the chrysanthemum to the Japanese, the tulip to the Dutch, the fern to New Zealanders, the mangoes to the Indians and the citron to Israel. US currency, for example, is full of plants from the olive in the claw of the eagle, to the trees surrounding the US Treasury or the White House. There are hundreds of postage stamps devoted to horticulture from many countries around the world and horticultural images also feature on banknotes and coins in many countries.

Garden plants have become key elements in religions since they are a source of sustenance, medical cures, aroma and delight. It is no wonder that horticulture and religion are interconnected. Some types of horticultural practice have taken on the sheen of religious practices themselves. Examples include planting based on the phases of the moon, the organic movement where certain plant practices are endowed with elevated spiritual values while others are considered sinful; special diets where certain foods are ritually clean and others prohibited, and the environmental movement which has developed a natural ethos of its own that begins to resemble religious beliefs in some instances.

## 8. Conclusions

In conclusion, horticulture is so basic to human existence that it is no wonder that horticultural plants and practices have permeated so deeply into our cultures. The universal appeal of its beloved plants with their delightful fragrances and delicious flavors and beauty, their health and medicinal values, and their importance in the environment, underscores the close relationship of horticulture to humans and humanity. Horticulture truly feeds us, sustains and cures us, and makes life worth living. It provides food for body and soul.



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