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COMPANION PLANTING: BASIC CONCEPTS & RESOURCES

HORTICULTURE TECHNICAL NOTE

ATTRA is the national sustainable agriculture information center funded by the USDA's Rural Business--Cooperative Service.

Abstract: *Companion planting is based on the idea that certain plants can benefit others when planted in near proximity. The scientific and traditional bases for these plant associations are discussed. A companion planting chart for common herbs, vegetables, and flowers is provided, as is a listing of literature resources for traditional companion planting. An appendix provides history, plant varieties, and planting designs for the Three Sisters, a traditional Native American companion planting practice.*

By George Kuepper & Mardi Dodson
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Traditional Companion Planting

Companion planting can be described as the establishment of two or more plant species in close proximity so that some cultural benefit (pest control, higher yield, etc.) is derived. The concept embraces a number of strategies that increase the biodiversity of agroecosystems.

Generally, companion planting is thought of as a small-scale gardening practice. However, in this discussion the term is applied in its broadest sense to include applications to commercial horticultural and agronomic crops. ATTRA has another publication, *Intercropping Principles and Production Practices*, that provides additional information on larger-scale applications.

While companion planting has a long history, the mechanisms of beneficial plant interaction have not always been well understood. Traditional recommendations (see summary chart provided as Table 1) used by gardeners have evolved from an interesting combination of historical observation, horticultural science, and a few unconventional sources. For example, some of the recommendations for companion planting, made around the middle of this century, were based on the results of sensitive crystallization tests (1).

Originally developed by Dr. Ehrenfried Pfeiffer, sensitive crystallization testing entails the mixing of plant extracts with select salt reagents like sodium sulfate or copper chloride. The resulting solution is placed in a controlled environment chamber and allowed to evaporate slowly. The process results in a precipitate that often takes on beautiful geometric forms and patterns. The characteristics of the pattern are studied and interpreted to establish whether the plants are likely to interact well with each other (1). Sensitive crystallization appeals to practitioners of Biodynamics™ (BD) and others who take a more metaphysical approach to nature. Conventional science is much more skeptical of this process as a means to evaluate plant associations.

Contents:

Table 1. COMPANION PLANTING CHART FOR HOME & MARKET GARDENING
(compiled from traditional literature on companion planting)

CROP:	COMPANIONS:	INCOMPATIBLE:
Asparagus	Tomato, Parsley, Basil	
Beans	Most Vegetables & Herbs	Onion, Garlic, Gladiolus
Beans, Bush	Irish Potato, Cucumber, Corn, Strawberry, Celery, Summer Savory	Onion
Beans, Pole	Corn, Summer Savory, Radish	Onion, Beets, Kohlrabi, Sunflower
Beets	Cabbage & Onion Families, Lettuce	Pole Beans
Cabbage Family	Aromatic Herbs, Celery, Beets, Onion Family, Chamomile, Spinach, Chard	Dill, Strawberries, Pole Beans, Tomato
Carrots	English Pea, Lettuce, Rosemary, Onion Family, Sage, Tomato	Dill
Celery	Onion & Cabbage Families, Tomato, Bush Beans, Nasturtium	
Corn	Irish Potato, Beans, English Pea, Pumpkin, Cucumber, Squash	Tomato
Cucumber	Beans, Corn, English Pea, Sunflowers, Radish	Irish Potato, Aromatic Herbs
Eggplant	Beans, Marigold	
Lettuce	Carrot, Radish, Strawberry, Cucumber	
Onion Family	Beets, Carrot, Lettuce, Cabbage Family, Summer Savory	Beans, English Peas
Parsley	Tomato, Asparagus	
Pea, English	Carrots, Radish, Turnip, Cucumber, Corn, Beans	Onion Family, Gladiolus, Irish Potato
Potato, Irish	Beans, Corn, Cabbage Family, Marigolds, Horseradish	Pumpkin, Squash, Tomato, Cucumber, Sunflower
Pumpkins	Corn, Marigold	Irish Potato
Radish	English Pea, Nasturtium, Lettuce, Cucumber	Hyssop
Spinach	Strawberry, Faba Bean	
Squash	Nasturtium, Corn, Marigold	Irish Potato
Tomato	Onion Family, Nasturtium, Marigold, Asparagus, Carrot, Parsley, Cucumber	Irish Potato, Fennel, Cabbage Family
Turnip	English Pea	Irish Potato

The Scientific Foundations for Companion Planting

While conventional agriculturalists and BD practitioners may disagree over the validity of sensitive crystallization research, there is general agreement today on the validity of several mechanisms that create beneficial plant associations:

√ *Trap cropping.* Sometimes, a neighboring crop may be selected because it is more attractive to pests and serves to distract them from the main crop. An excellent example of this is the use of collards to draw the diamond back moth away from cabbage (2).

√ *Symbiotic nitrogen fixation.* Legumes—such as peas, beans, and clover—have the ability to fix atmospheric nitrogen for their own use and for the benefit of neighboring plants via symbiotic relationship with *Rhizobium* bacteria. Forage legumes, for example, are commonly seeded with grasses to reduce the need for nitrogen fertilizer. Likewise, beans are sometimes interplanted with corn. On request ATTRA can provide additional information on *Rhizobium* inoculation.

√ *Biochemical pest suppression.* Some plants exude chemicals from roots or aerial parts that suppress or repel pests and protect neighboring plants. The African marigold, for example, releases thiopene—a nematode repellent—making it a good companion for a number of garden crops. The manufacture and release of certain biochemicals is also a factor in plant antagonism. Allelochemicals such as juglone—found in black walnut— suppress the growth of a wide range of other plants, which often creates a problem in home horticulture. A positive use of plant allelopathy is the use of mow-killed grain rye as a mulch. The allelochemicals that leach from rye residue prevent weed germination but do not harm transplanted tomatoes, broccoli, or many other vegetables.

√ *Physical spatial interactions.* For example, tall-growing, sun-loving plants may share space with lower-growing, shade-tolerant species, resulting in higher total yields from the land. Spatial interaction can also yield pest control benefits. The diverse canopy resulting when corn is companion-planted with squash or pumpkins is believed to disorient the adult squash vine borer and protect the vining crop from this damaging pest. In turn, the presence of the prickly vines is said to discourage raccoons from ravaging the sweet corn.

√ *Nurse cropping.* Tall or dense-canopied plants may protect more vulnerable species through shading or by providing a windbreak. Nurse crops such as oats have long been used to help establish alfalfa and other forages by supplanting the more competitive weeds that would otherwise grow in their place. In many instances, nurse cropping is simply another form of physical-spatial interaction.

√ *Beneficial habitats.* Beneficial habitats—sometimes called *refugia*—are another type of companion plant interaction that has drawn considerable attention in recent years. The benefit is derived when companion plants provide a desirable environment for beneficial insects and other arthropods—especially those predatory and parasitic species which help to keep pest populations in check. Predators include ladybird beetles, lacewings, hover flies, mantids, robber flies, and non-insects such as spiders and predatory mites. Parasites include a wide range of fly and wasp species including tachinid flies, and *Trichogramma* and ichneumonid wasps. Agroecologists believe that by developing systems to include habitats that draw and sustain beneficial insects, the twin objectives of reducing both pest damage and pesticide use can be attained. For detailed information on establishing beneficial habitats, request the ATTRA publication *Farmscaping to Enhance Biological Control*.

√ *Security through diversity.* A more general mixing of various crops and varieties provides a degree of security to the grower. If pests or adverse conditions reduce or destroy a single crop or cultivar, others remain to produce some level of yield. Furthermore, the simple mixing of cultivars, as demonstrated with broccoli in University of California research, can reduce aphid infestation in a crop (3).

Options For System Design

Agronomists use the term "intercropping" to describe the spatial arrangements of companion planting systems. Intercropping systems range from mixed intercropping to large-scale strip intercropping. Mixed intercropping is commonly seen in traditional gardens where two or more crops are grown together without a distinct row formation. Strip intercropping is designed with two or more crops grown together in distinct rows to allow for mechanical crop production. No-till planting or transplanting into standing cover crops can be considered another form of intercropping. For more information on no-till planting, request the ATTRA publication *Conservation Tillage*.

Related ATTRA publications

- *Intercropping Principles and Production Practices*
- *Farmscaping to Enhance Biological Control*
- *Introduction to Permaculture*
- *Biodynamic Farming & Compost Preparation*
- *Conservation Tillage*

References:

1) Philbrick, Helen and Richard Gregg. 1966. Companion Plants & How To Use Them. The Devin-Adair Co., Old Greenwich, CT. 113 p.

2) Boucher, Jude. 2000. Setting a Trap. American Vegetable Grower. January. p. 20, 22.

3) Daar, S. 1988. Mixing Broccoli Cultivars Reduces Cabbage Aphids. IPM Practitioner. May. p. 12.

Resources:

Traditional Companion Planting

Bob Flowerdew's Complete Book of Companion Gardening. 1995. By Bob Flowerdew. Kyle Cathie, London, GB. 176 p.
Available online from Trafalgar Square Books for $24.95 plus $5 shipping and handling
http://www.trafalgarsquare books.com

Carrots Love Tomatoes: Secrets of Companion Planting for Successful Gardening, 2nd edition. 1998. By Louise Riotte. Storey Communications, Pownal, VT. 226 p.
Available for $15 plus $3 p&h from:
Acres USA
P.O. Box 91299
Austin, TX 78709
800-355-5313
512-892-4448 Fax
Email: info@acresusa.com

Companion Plants and How To Use Them. 1966. By H. Philbrick and R. Gregg. Devin-Adair Publishers, Old Greenwich, CT. 113 p.
Available for $9.95 plus $4.50 p&h from:
Bio-Dynamic Farming and Gardening Association, Inc.
Building 1002B, Thoreau Center, The Presidio
P.O. Box 29135
San Francisco, CA 94129-0135
888-516-7797
415-561-7796 Fax
Email: biodynamic@aol.com
http://www.biodynamic.com

Great Garden Companions: A Companion-Planting System for a Beautiful, Chemical-Free Vegetable Garden. 1998. By Sally Jean Cunningham. Rodale Press, Emmaus, PA. 278 pages.
Available for $13.56 plus $4.48 shipping and handling from:
Amazon Books
http://www.amazon.com/

How To Grow More Vegetables Than You Ever Thought Possible On Less Land Than You Can Imagine, 5th edition. 1995. By John Jeavons. Ten Speed Press, Berkeley, CA. 228 p.
Contains an extensive companion planting chart.
Available for $16.95 plus $4.50 p&h from:
Bountiful Gardens
18001 Shafer Ranch Rd.
Willits, CA 95490-9626
707-459-6410

J. Howard Garret's Organic Manual. 1993. By J. Howard Garret. Lantana Publishing Co., Dallas, TX. 203 p.

A fine general guide on organic growing that features a brief table of companion herbs and the pests they repel on page 48. Available for $18 plus $3 p&h from:
Acres USA
P.O. Box 91299
Austin, TX 78709
800-355-5313
512-892-4448 Fax
Email: info@acresusa.com

Raising With The Moon: The Complete Guide to Gardening and Living by the Signs of the Moon. 1993. By Pyle & Reese. Down Home Press, Asheboro, NC. 147 p.

Contains both companion planting charts and a listing of insect repellent plants.
Available for $14 plus $3 p&h from:
Acres USA
P.O. Box 91299
Austin, TX 78709
800-355-5313
512-892-4448 Fax
Email: info@acresusa.com

Rodale's Successful Organic Gardening: Companion Planting. 1994. By McClure and Roth. Rodale Press, Emmaus, PA. 160 p.

Available for $14.95 plus $4.50 p&h from:
Bountiful Gardens
18001 Shafer Ranch Rd.
Willits, CA 95490-9626
707-459-6410

Roses Love Garlic: Companion Planting and Other Secrets of Flowers. 1998. By Louise Riotte. Storey Communications, Pownal, VT. 240 p.

Available for $ 11.96 plus $4.48 shipping and handling from: Amazon Books
http://www.amazon.com/

Beneficial Habitats

To avoid redundancy in our publications, anyone seeking further information on beneficial habitats is encouraged to request ATTRA's publication titled *Farmscaping to Enhance Biological Control*. This publication also provides additional references for further research. Other ATTRA publications that might be helpful for designing and managing beneficial habitats include *Biointensive Integrated Pest Management* and *Overview of Cover Crops and Green Manures*.

Intercropping Research

ATTRA's *Intercropping Principles and Production Practices* and *Farmscaping to Enhance Biological Control* publications are good sources for basic information on intercropping. The following publications should prove useful.

"Border effects on yields in a strip-intercropped soybean, corn, and wheat production system." 1996. By T.K. Iragavarapu and G.W. Randall. Journal of Production Agriculture. Vol. 9, No. 1. p. 101-107.

Provides a nice literature review of research to that time on intercropping, highlighting the multitude of factors causing variability in results.

Multiple Cropping. 1976. ASA Special Publication No. 27. American Society of Agronomy, 677 So. Segoe Rd., Madison, WI. 378 p.

"Strip intercropping for biological control." 1993. By Joel Grossman and William Quarles. The IPM Practitioner. April. p. 1–11.

An excellent synopsis of intercropping. The IPM Practitioner, published 10 times per year, is a benefit of membership in the Bio-Integral Resource Center (BIRC). Annual membership for individuals costs $35. Contact:
BIRC
P.O. Box 7414
Berkeley, CA 94707
Tel: 510-524-2567

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Ancient Companions

An Appendix to Companion Planting: Basic Concepts & Resouces

By Mardi Dodson

Introduction

For centuries, many Native American tribes throughout North America have cultivated corn, beans, and squash. The term "Three Sisters" was primarily used by the Iroquois who live in the Northeastern United States and Canada. These crops were considered to be special gifts from Great Spirit and were believed to be protected by the Three Sisters—spirits collectively called the De-o-ha-ko, meaning "our sustainers" or "those who support us" (1).

This ancient style of companion planting has played a key role in the survival of all people in North America. Grown together these crops are able to thrive and provide high-yield, high-quality crops with a minimal environmental impact. Corn, beans, and squash have a unique symbiotic relationship in a Native American garden. Corn offers a structure for the beans to climb. The beans, in turn, help to replenish the soil with nutrients. And the large leaves of squash and pumpkin vines provide living mulch that conserves water and provides weed control.

Contents:

The Legend of the Three Sisters

The term "Three Sisters" emerged from the Iroquois creation myth. It was said that the earth began when "Sky Woman" who lived in the upper world peered through a hole in the sky and fell through to an endless sea. The animals saw her coming, so they took the soil from the bottom of the sea and spread it onto the back of a giant turtle to provide a safe place for her to land. This "Turtle Island" is now what we call North America.

Sky woman had become pregnant before she fell. When she landed, she gave birth to a daughter. When the daughter grew into a young woman, she also became pregnant (by the West wind). She died while giving birth to twin boys. Sky Woman buried her daughter in the "new earth." From her grave grew three sacred plants—corn, beans, and squash. These plants provided food for her sons, and later, for all of humanity. These special gifts ensured the survival of the Iroquois people (2).

Corn

Corn is considered the most important of all Native American crops. Originating in South America and Mexico, corn was introduced during the Mississippian Period (600 A.D. to 1450 A.D.) to North American tribes via an intricate series of trade networks. Corn, beans, and squash combine to create a nearly perfect meal loaded with essential vitamins and minerals (2). In addition to its nutritional values, all Native American tribes that grew corn considered it a sacred and spiritually valuable plant.

Varieties

Choosing the right varieties of corn is essential to the success of a Three Sisters garden. The tall, sturdy heirloom varieties work best because they are most capable of supporting the beans. There are a number of Native American heirloom corn varieties to choose from. Traditionally, most of the corn grown

by Native Americans is dry field corn, which is used in flour production. Dry field corn is harvested late in the season when the ears have dried on the stalk.

Dry field corn is divided into three categories, *dent, flint,* and *flour* corns. *Dent* corns are adapted best to the Southeast and the Midwest. Dent corn has a distinctive dimple-like dent on top of the kernel when it is fully dried. A dent corn that grows well most anywhere in the United States is the **Cherokee Blue and White** of the Southeast. **Reid's Yellow Dent** is also widely adapted. **Bloody Butcher** produces blood-red ears of corn on stalks that can reach from 10 to 12 feet (2, 3).

Flint corn grows best in the northern plains region. The kernels of flint corn do not shrink when they are dry. A popular flint corn is **Indian Ornamental** with colors ranging from purple to yellow. Two popular flint corn varieties are **Fiesta** and **Little Jewels**. **Little Jewels** is a unique, "mini" ornamental with four-inch-long, multi-colored ears and purple husks (3).

Flour corns usually have thinner-shelled kernels filled with soft white starch. Flour corns were developed in the arid Southwest. They are less likely to succeed in cooler northern regions with short growing seasons and in moist, humid areas where they are susceptible to a fatal rust disease. **Hopi Pink** is a short, drought-resistant corn, with kernels that range in color from cranberry to light pink. This variety has plump, thin-shelled kernels that grind easily into fine flour. A flour corn that works well in northern gardens is **Mandan Bride**. This variety is also drought-tolerant, with red, blue, yellow, pink, and purple spotted kernels (3).

Corn can be harvested earlier in the season when it is still "green corn." Green corn is harvested when the corn is still in the "milk" stage, when the kernels are at their sweetest and can be eaten fresh. Varieties that are sweet when young are **Blue Clarage, Bloody Butcher,** and **Black Mexican/Iroquois.** Flour corns are usually not eaten in the green corn stage. Two exceptions to this rule are **Anasazi** and **Mandan Red**. (3). See Table 1.

Table 1: Colorful Corn Varieties

Variety	Type	Color	Can Be Eaten Fresh	Comments
Anasazi	Flour	Multi	✓	Ancient Southwestern variety, drought-tolerant
Beasley's Red Dent	Dent	Red		Heirloom from Indiana
Black Mexican/Iroquois	Sweet	Blue-Black	✓	Smaller variety from the Northeast
Black Aztec	Sweet	Blue, Black, Purple	✓	Originated from southern Mexico
Bloody Butcher	Dent	Red	✓	Northeastern United States, Virginia area
Blue Clarage	Dent	Blue	✓	Ohio/West Virginia
Bronze-Orange	Sweet	Bronze-Orange	✓	Selected by Dr. Alan Kapuler
Cherokee Blue & White	Dent	Blue and White	✓	Grown throughout North America
Cherokee White	Flour	White		Grows 12-15ft. Tall
Fiesta	Flint	Multi		Developed in New Hampshire
Hopi Pink	Flour	Pink		Short, drought-tolerant, Southwestern variety
Hickory King	Flour	Yellow		12 ft. tall heirloom
Indian Ornamental	Flint	Multi		Widely grown by North American Indians
Little Jewels	Flint	Multi		4-inch-long corn developed in New Hampshire
Mandan Bride	Flour	Multi		Originated from the Mandan tribe
Mandan Red	Flour	Reddish-Black	✓	Developed in Washington
Oaxaca Green	Dent	Green		Southern Mexico, makes green flour
Rainbow Inca	Sweet	Multi	✓	Developed by Dr. Alan Kapuler
Rainbow Indian	Flour	Multi		Developed by Dr. Alan Kapuler
Texas Honey June	Sweet	Yellow	✓	Heirloom, sturdy 7-8ft. Stalks
Tuscadorea/Iroquois White	Flour	White		Tall, Iroquois variety

*Adapted from Amazing Maize! Cultivate Colorful Corns by Eric Rosenthal (3).

Beans

Beans provide a high-quality protein food source that combines well nutritionally with corn. Beans also play a valuable role in the Three Sisters garden. Through a symbiotic relationship with rhizobium bacteria, beans help to take nitrogen from the air and convert it into a usable form for next year's crop.

Varieties

Pole beans are best adapted to directly climb the corn stalk as opposed to sending runners across the ground. The **Scarlet Runner** variety is a popular heirloom pole bean that is famous for its large clusters of bright red flowers. **Genuine Cornfield** consistently produces in the heat of Southern summers. **True Cranberry**, a dark red bean with a meaty texture and a nutty chestnut-like flavor, also performs well in the South and in the Northeast. **Cornfield,** unrelated to **Genuine Cornfield**, does well in the Pacific Northwest because it matures before the fall rains come. A favorite in the arid Southwest is **Hopi Purple**, a purple bean with black crescent moon stripes (2).

Squash

Growing low to the ground, squash and pumpkin serve as living mulch. The large leaves block out much of the sunlight, thus reducing weed seed germination.
Allelopathy may be an additional factor in weed suppression(4). (*Allelopathy* refers to chemical secretions from a plant which have adverse or phytotoxic effects on some weed species).

Varieties

Most any variety of squash will work in a Three Sisters garden. In addition to the contemporary hybrid varieties, there are still some traditional varieties available. In the Northeast, the Penobscot and Abenaki still grow **Long Pie** (a.k.a. **Indian** or **Golden Oblong)** pumpkin.

This pumpkin looks like a fat zucchini with the texture of a pumpkin. It has a long storage life and usually doesn't turn orange until after it is harvested. A disease-resistant variety suited for the Southeast is the **Connecticut Field**. This very vigorous Native American heirloom yields large, bright orange pumpkins. **Mayo Blusher** is a very sweet, pale gray pumpkin that blushes pink when ripe. **Cushaw** is a gourd-like squash that has been grown in the Southwest by the Pueblo Indians for storage containers since pre-Columbian times. Other varieties of squash also grow well in the Southwest depending on the amount of moisture available (2).

Cultivation and Planting Designs

Planting designs and cultivation practices vary according to climatic region. Garden styles were developed mainly out of practical considerations, such as moisture availability, climate, and the length of the growing season. The Wampanoag garden style works well east of the Mississippi. Hidatsa gardens were developed to thrive in the climate of the northern Plains, while the Zuni waffle gardenwas designed to conserve water in the arid Southwestern climate.

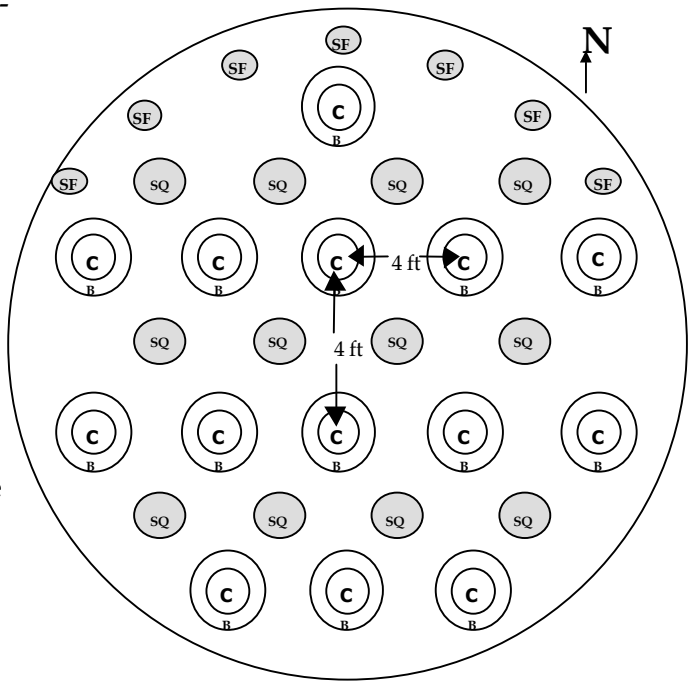


Figure 1: **Circular Wampanoag Garden**

Drawing by Mardi Dodson
Concept taken from Native American Gardening by Michael J. Caduto and Joseph Bruchac

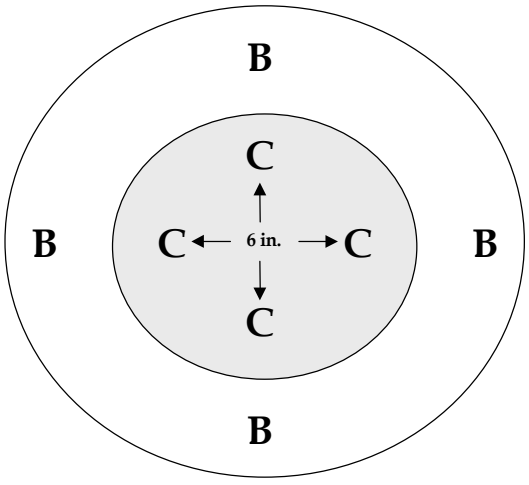
Wampanoag Three Sisters Garden

It was the Wampanoag gardens that enabled the early settlers of Jamestown to survive and thrive in the New World. Squanto was a Wampanoag who "taught the newcomers to plant maize in little hills and fertilize each mound with an alewife, a species of fish" (5). With this efficient and intensive gardening style, each family could sustain their needs on about one acre of land. Many of the tribes of the Northeast, including the Iroquois, used the Wampanoag garden design.

Planted without plowing or tilling, the traditional Wampanoag garden includes corn, beans, squash, and sunflowers. The corn and beans are planted in mounds, with squash planted between the mounds. The sunflowers are planted along the north edge of the garden, so that they do not cast a shadow on the other crops (see Figure 1). When the sunflowers have bloomed and the squash and beans have flowered, the Wampanoag Three Sisters garden becomes a stunning cluster of red, yellow, and white flowers against a textured backdrop of shimmering greens.

First, the raised corn and bean mounds must be constructed. These small mounds are laid out in rows with 4 feet between the *centers* of the mounds (see Figure 1). Each mound is about 4 inches high, with a wide base (about 18 inches in diameter) that narrows to a flattened top (about 10 inches across). To conserve moisture, a depression with a lip may be formed at the top of each mound (6). The finished mounds have a remarkable resemblance to miniature moon craters.

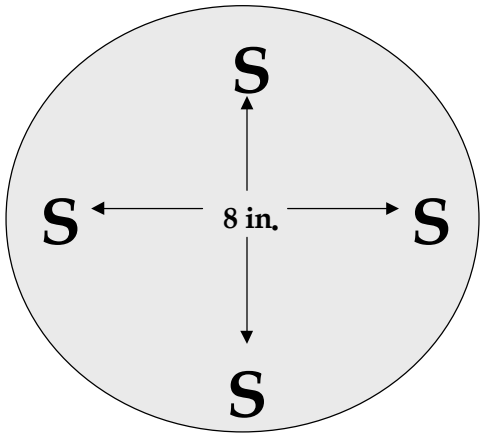
Figure 2: **Wampanoag Corn & Bean Mound**



Corn is planted 6 inches apart in the flat top of the mound. Beans are planted halfway down the slopes on the sides of the mound.

Drawing by Mardi Dodson
Concept taken from Native American Gardening by Michael J. Caduto and Joseph Bruchac

Figure 3: **Wampanoag Squash Mound**



Drawing by Mardi Dodson
Concept taken from Native American Gardening by Michael J. Caduto and Joseph Bruchac

When the mounds are ready, plant four corn seeds about 6 inches apart and 3 inches deep in the top of each mound. Once the corn has grown to a height of 4 inches or more, plant four beans seeds halfway down the slopes on the sides of each mound (see Figure 2). Allow the bean vines to entwine themselves around the cornstalks for support. The bean vines may be pruned if they get too aggressive (6).

Squash seedlings are planted at the same time as the beans. Construct rounded mounds 3 inches high and about 1 foot across at the base. The squash mounds are staggered *between* the mounds of corn and beans (see Figure 1). Traditionally, four seedlings are planted in the top of each mound. The seedlings are arranged to represent each of the four sacred directions (see Figure 3). Both winter and summer va[redacted]nted, including pumpkins, acorn s[redacted]summer crookneck squash (6).

Sunflower s[redacted]nted at the same time as the corn. [redacted]-flowering common sunflower, *H[redacted]nus*, is traditionally grown in a W[redacted] Three Sisters garden.

The sunflower mounds are located at the north edge of the garden (see Figure 1). The mounds are spaced about three feet apart from center, with three seeds planted (one seed per hole) atop each mound. The sunflowers seeds are traditionally harvested after the first frost (6).

Hidatsa Gardens

In the northern plains, the Hidatsa, Mandan, and Arikara peoples gardened along the floodplain of the Missouri River in what is now called North Dakota. Most of the tribes in this region used the Hidatsa garden design (see Figure 4). Hidatsa gardens are designed to have alternating, staggered rows of corn and beans, with sunflowers growing along the north edge of the garden. Squash is planted after every fourth row of corn and beans and around the east, south, and west edges of the garden (6).

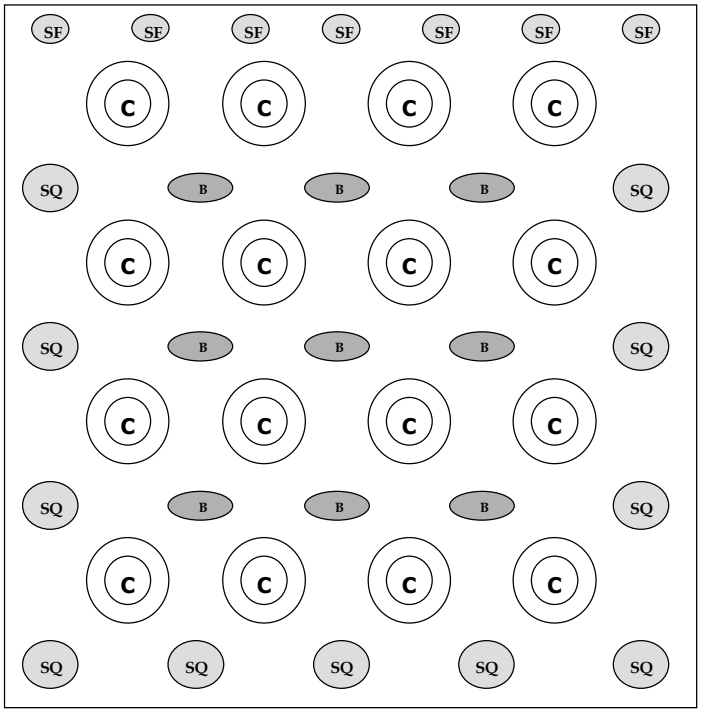
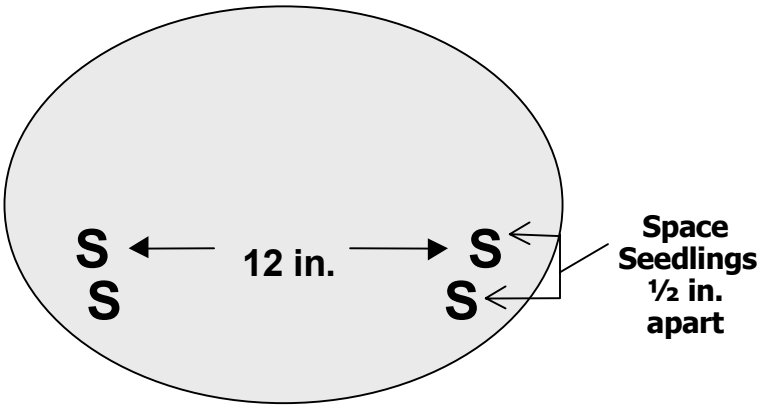


Figure 4: **Hidatsa Garden Design**

Sunflowers are planted as soon as the threat of frost has passed. As in the Wampanoag garden, three sunflower seeds are planted in small mounds 3 feet apart along the north edge of the garden. The Hidatsa garden differs from the Wampanoag garden when it comes to seed arrangement—all three seeds are planted in *one hole*. Hidatsa varieties of sunflower produce black, red, white, and striped seeds (6).

Plant squash indoors in peat pots or seed flats when the sunflowers are planted in the garden. Before planting in the garden, prepare the squash mounds (about 15 inches across at the base), with 4 feet between the centers of the mounds. The squash mounds are located along the east, west, and south edges of the garden in alignment with the rows of beans (see Figure 4). Squash seedlings are usually transplanted when they are about 4 inches tall and have put on their first set of true leaves (about two weeks after the corn is planted). To protect them from the heavy spring rains, four seedlings are planted on the sides of the mound in sets of two, 12 inches apart (see Figure 5) (6).

Figure 5: **Hidatsa Squash Mound**



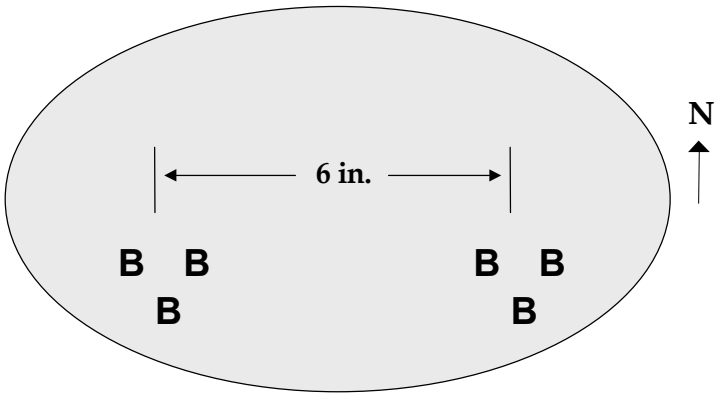
In the Hidatsa garden, there are usually four corn mounds per row of corn. Note that the rows of corn are in alignment but are staggered in comparison to the beans (see Figure 4). Hidatsa corn mounds are constructed in the same way as the Wampanoag corn and beans mound. The differences are that only corn is planted in these mounds and eight

Drawing by Mardi Dodson
Concept taken from Native American Gardening by Michael J. Caduto and Joseph Bruchac

seeds, instead of four, are planted in the top of each mound (see Figure 6). Growing corn together in bunches offers extra support and protection from wind and rain damage.

Hidatsa flint corn is planted in May in North Dakota when the leaves of the Gooseberry shrubs have emerged and fully formed. Corn is planted a week or two after the sunflowers have been planted. This flint corn is a semiarid variety with a growing season of about 70 days. It is advisable to research which corn variety works best for your zone and climatic conditions (7).

Figure 6: **Hidatsa Bean Mound**

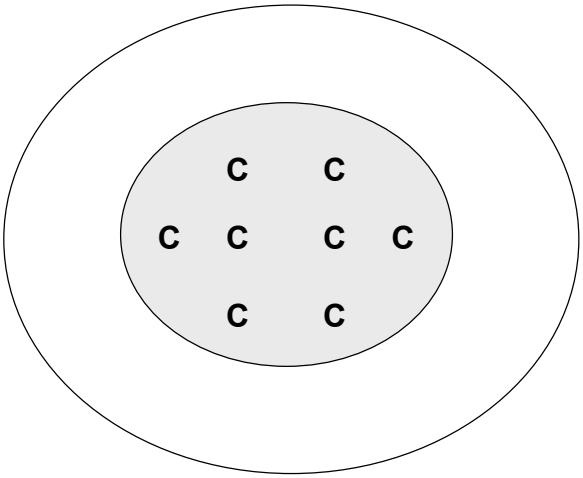


Bean seeds are planted on the south-facing slope of the mound. One seed is planted per hole, with a total of six seeds planted in each mound.

Drawing by Mardi Dodson
Concept taken from Native American Gardening by Michael J. Caduto and Joseph Bruchac

Beans are planted at the same time as corn. In a Hidatsa garden, beans are planted separately from the corn in their own mounds. The bean mounds are located between the rows of corn in a staggered, alternating pattern (see Figure 4). The mounds are rounded ovals, about 4 inches tall by 7 inches wide by 14 inches long. Traditionally, two people worked together to plant beans. The first person made six holes in the south-facing slope of the bean mound. This is done in one swift motion by thrusting both hands into the soil with the thumb and first two fingers extended to make two sets of holes spaced 6 inches apart (see Figure 7). The second person follows behind and plants one seed in each hole. A total of six seeds are planted in each bean mound (7).

Figure 7: **Hidatsa Corn Mound**



In a Hidatsa garden, eight seeds are planted atop each mound.

Drawing by Mardi Dodson
Concept taken from Native American Gardening by Michael J. Caduto and Joseph Bruchac

Zuni Waffle Garden

The Zuni live in the Four Corners area of the Southwestern United States. This arid climate at altitudes over 7,000 feet makes gardening a special challenge. The Wampanoag and Hidatsa garden designs use raised mounds to keep the root systems from being waterlogged. In contrast, the focus of this garden is *water conservation*. The waffles are about 12 feet by 12 feet. Each individual square is *indented* and surrounded by a high rim. In each square, a single crop or combinations of crops may be planted (see Figure 8). This garden design will work anywhere in the country where dry summer conditions are experienced.

Traditionally, the crops are planted intensively with five to eight corn seeds in each hole to create clumps of corn similar to those in the Hidatsa garden. Corn seeds are planted 4-8 inches deep in light sandy soils and about 4 inches deep or less in heavier clay soil. Beans and squash have the same planting depths and spacing requirements as corn (8). The same number of beans (4-8 seeds) ar[redacted]ound each clump of corn, one seed[redacted]nly one or two squash planting[redacted]n each hole) are added to each waf[redacted]re 8) (3). As with the other two desi[redacted]ers may also be planted along the[redacted]e Zuni Waffle garden.

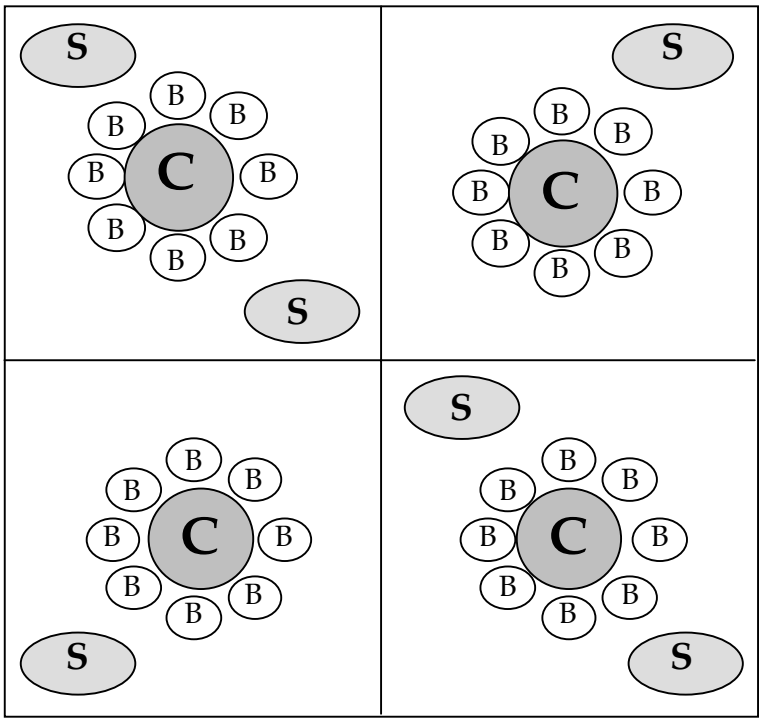


Figure 8: **Zuni Waffle Garden**

Drawing and Design by Mardi Dodson

Helianthus maximilianii, a small sunflower with flower heads about 3 inches wide, is most commonly grown in the Southwest (9).

Summary

Native American tribes of North America have made enormous contributions to the foods we eat today. The dynamic trio known as the *Three Sisters* not only thrive when they are planted together, they offer a well-balanced, nutritious meal. Over the centuries, many plant varieties and gardening styles were developed for each major climatic region. The Wampanoag (Northeast and South), Hidatsa (Plains), and Zuni waffle garden (Southwest) offer a range of gardening styles to accommodate most growing conditions found in North America.

Corn, beans, and squash have a unique symbiotic relationship in a Native American garden. Corn offers a structure for the beans to climb. The beans, in turn, help to replenish the soil with nutrients. And the large leaves of squash and pumpkin vines provide living mulch that conserves water and provides weed control. This ancient style of companion planting has played a key role in the survival of all people in North America. Grown together these crops are able to thrive and provide high-yield, high-quality crops with a minimal environmental impact.

References

1. Eames-Sheavly, Marcia. No date. The Three Sisters: Exploring an Iroquois Garden. Cornell University Cooperative Extension. p. 7.

2. Erney, Diana. 1996. Long live the Three Sisters. Organic Gardening. November. p. 37–40.

3. Rosenthal, Eric. 1993. Amazing maize! Cultivate colorful corns. Organic Gardening. March. p. 30–35.

4. Fujiyoshi, Phillip. 1998. Mechanisms of Weed Suppression By Squash (Cucurbita spp.) Intercropped in Corn (Zea mays L.). Dissertation University of California Santa Cruz.

5. Gabarino, Merwin S. and Sasso, Robert F. 1994. Native American Heritage. Waveland Press, Prospect Heights, Illinois. p. 308

6. Caduto, Michael J. and Burchac, Joseph. 1996. Native American Gardening. Fulcrum Publishing, Golden, Colorado. p. 70–93.

7. Wilson, Gilbert L. 1917. Agriculture of the Hidatsa Indians. Minnesota Historical Society Press, St. Paul, Minnesota. 129 p.

8. Talavaya Center. No date. Talavaya Seed and Planting Manual. Espanola, New Mexico. p. 5–11.

9. Buchanan, Carol. 1997. Brother Crow, Sister Corn. Ten Speed Press, Berkeley, California. 119 p.

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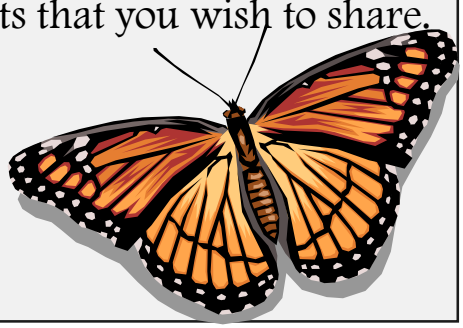

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