Reuniting the Three Sisters: Native American Intercropping and Soil Health

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Emma Herrighty and Derrick Kapayou,
graduate research assistants
Ajay Nair, associate professor/extension
vegetable specialist
Department of Horticulture
Christina Gish Hill, associate professor
Department of World Languages and Cultures
Marshall McDaniel, assistant professor
Department of Agronomy
Donna Winham, assistant professor
Department of Food Science
and Human Nutrition

Introduction

A growing movement within Native American communities is the revitalization of cultural growing practices. Significant to this is the traditional intercropping system of corn, beans, and squash, known colloquially as the Three Sisters. This system is well-known for the symbiosis of the plants and their biological functions for being planted together. The corn provides structural support, and bean fixes nitrogen in the soil for the other plants. Sister squash provides ground cover, increasing soil moisture and suppressing weed growth. Each plant has its own unique role, contributing to the overall health and productivity of the system. From a social perspective, these crops also fulfill required dietary needs, providing starches, protein, vitamins, and minerals. Therefore, the growing of the Three Sisters can have significance for improving food security and human health.

Despite these benefits, very little research has been conducted on the historical, cultural, and nutritional importance of the Three Sisters Intercropping (3SI). The revitalization of this practice could have tremendous implications for community, ecological, and soil health – not to mention additional significances of improving food security and food sovereignty.

Therefore, the objective of this interdisciplinary study is to engage with Native growers in communities throughout the Midwest to assess the cultural, nutritional, and agricultural importance of the 3SI. In collaboration with Native communities, and with an emphasis on citizen science, a Three Sisters garden plot has been designed to evaluate the impact of the intercropping on soil health and yield. The rationale is that growing the 3SI will result in improved soil health and crop yield, when compared with monocultures of each of the crops.

Materials and Methods

This project is established in collaboration with a Native advisory board to determine culturally appropriate growing and research practices. With this mindset, it was necessary to select Native Three Sisters varieties to use in the research project. Crops from Native American origins and specifically suited to the 3SI were obtained through the USDA National Plant Germplasm System as well as from other donors. The corn, Turtle Mountain White, was obtained from the USDA Plant Introduction Station, Ames, Iowa. The bean variety, Hidatsa Red, was donated by Seed Savers Exchange, Decorah, Iowa. The squash, the Algonquin Long Pie Pumpkin, was donated by Sierra Seeds, Nevada City, California.

This research was conducted on certified organic land at the ISU Horticultural Research Station, Ames, Iowa. Before the season began, compost was applied at the rate of 10 tons/acre. Experiment layout consisted of a

randomized complete block design, with four replications of each treatment (3SI, corn, bean, squash). Each treatment plot was 20 ft x 20 ft. Each plot contained 16 mounds, approximately 3 ft in diameter, per traditional Native gardening methods. Each mound was spaced 5 ft apart (center to center). Mounds were constructed by hand, piling soil into the center of raised beds. Before planting, an aggregate soil sample from each of the treatments was collected to create a baseline soil nutrient and health profile.

Planting in the mounds followed traditional 3SI designs, with plants always placed in the same position, regardless of whether the treatment was a monoculture or the complete intercropping (Figure 1).

Traditionally, all crops are direct seeded for the 3SI. However, due to a late season start due to the COVID-19 pandemic, all seeds were started in the greenhouse except for corn. Corn, the first sister to be planted, was direct seeded June 4, 2020. Overhead irrigation was installed once the corn began to sprout and reached a few inches in height. Beans and squash were seeded in the greenhouse (BLP Organic Growing Mix # 13) June 23, three weeks after the corn had been planted, following traditional planting schedules. On June 30, there were visible N deficiency symptoms in corn, which was corrected by applying Sustane Natural Fertilizer (4-6-4), Inc. (Cannon Falls, MN) at a rate of 60 lb/acre. The fertilizer was applied only to the mounds. On July 8, beans were transplanted into the field. For the bean monocrop treatments, an A frame using bamboo stakes was installed to mimic the support that corn offers in the 3SI. Squash seedlings were fertigated in the greenhouse with Phytamin Fish Plus, and transplanted July 12, reuniting all the sisters in the field.

Corn silking was first noticed during the second week of July, approximately a week earlier than expected. Corn smut became a major issue the last week of July and into early August, with the fungus taking over entire ears. Squash plants began flowering at this time, while beans remained stunted due to the late transplanting. Beans finally began to flower and develop pods in mid-August.

Results and Discussion

On August 10, the derecho razed the entire plot to the ground and damaged the crop. Between damage from smut and the derecho, almost 75 percent of corn was damaged. Due to this, no data was collected on corn yield at harvest. The beans recovered, though these remained stunted and did not produce or perform well in any of the treatments. The squash, on the other hand, flourished. The variety was excessively viny and did overtake and smother the grounded corn and diminutive beans, resulting in poor yields in the 3SI for those crops. End of the season soil samples were collected September 9 and sent to AgSource Laboratories, Ellsworth, Iowa, for analysis. The combined effects of the late planting and derecho negatively affected crop performance and yield (Table 1). In addition, corn smut adversely affected the corn. Despite these issues, soil analysis revealed the 3SI treatment resulted in significantly higher levels of soil CO_2 respiration and nitrate ppm, when compared with monoculture treatments (Figure 3). Year 2020 was the first growing season in the study and was not ideal. Better crop performance is expected in subsequent years, when further data will be collected to showcase differences or changes in soil chemical and biological properties.

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Table 1. Average yield (number and weight) of bean and squash at the ISU Horticulture Research Station, Ames, Iowa.

Crop	Monoculture		Three Sisters Intercropping	
	Number	Weight (kg)	Number	Weight (kg)
Corn	-	-	-	-
Bean	2,569	0.71	225	0.058
Squash	96	192.3	70	133.3

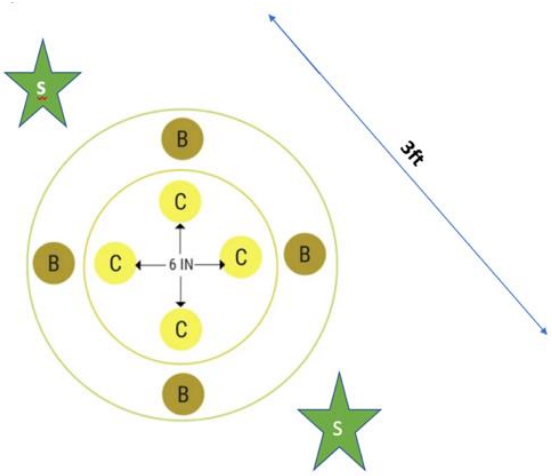

Figure 1. Planting configuration of the Three Sister Intercrop mound. B = bean, C = corn, and S = squash.

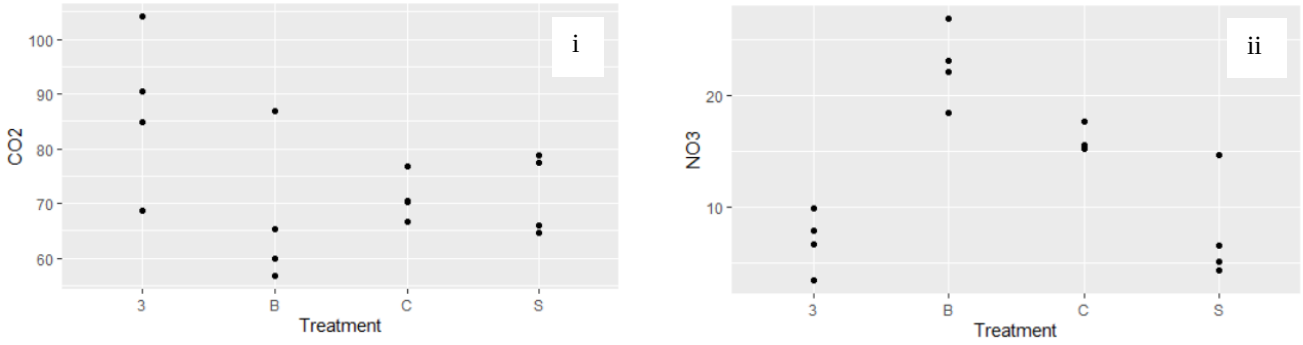

Figure 2. Soil CO_2 respiration (i) and nitrate concentration (ii) at the end of the growing season. Data reported in ppm. Treatment includes 3 = 3-sister intercrop, B = bean monocrop, C = corn monocrop, and S = squash monocrop.