TEXAS A&M AGRILIFE EXTENSION

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Harvest Gains from Intercropping

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Home gardeners and small-scale farmers can increase their properties' productivity by intercropping—growing two or more crops together on the same plot—using species that perform specific functions to benefit their companion crop (Fig. 1).

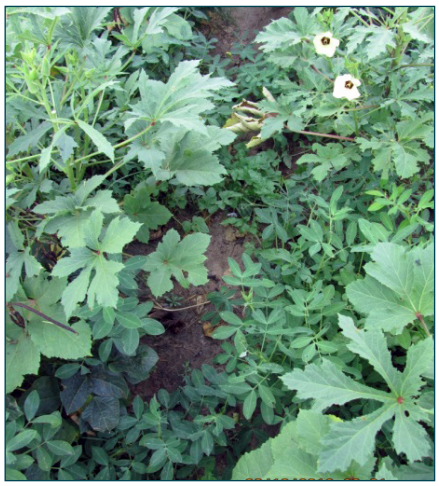

Figure 1. A mixed intercropping of peanuts, watermelons, and okra.

In a 2-year study, researchers with Texas A&M University and the Texas A&M AgriLife Extension Service planted five vegetable species: okra, peanuts, peas, peppers, and watermelon. Each species was grown separately in different plots (monoculture) as well as intercropped with other species.

The vegetables were intercropped to take advantage of each species' natural benefits to the other crops (Table 1):

- Peanuts and peas fix nitrogen from the air and supply it in the soil as nitrates to other plants.
- Watermelons shade the soil and suppress weeds.
- Okra also provides shade, and its flowers attract pollinators.
- Hot peppers provide a barrier to pests.

Two types of intercropping were used: *row intercropping,* in which a row of one crop was alternated with a row of another crop (Fig. 2); and *mixed intercropping,* in which plants of different species were alternated within each row (Fig. 3).

The species combinations and intercropping systems included:

- Peanuts and watermelon, mixed intercrop
- Peanuts and watermelon, row intercrop
- Okra, peanuts, and watermelon, mixed
- Okra, peanuts, peas, and watermelon, mixed
- Okra, peanuts, peas, peppers, and watermelon, mixed

Individual plants of all species were spaced about 12 inches (30 cm) apart, arranged so that each plant was neighbored by a legume species and another species.

Table 1. Varieties and functions of crops used in the Texas A&M University and AgriLife Extension Service study

Crop	Variety	Function	Growth form
Okra	Clemson Spineless	Attract pollinators, provide structural support	Tall
Pea	Texas Pinkeye	Fix nitrogen, attract pollinators	Mid
Peanut	Tamspan 90	Fix nitrogen, smother weeds	Low/mid
Pepper	Jalapeño/serrano	Repel pests	Mid
Watermelon	TAMU Mini	Smother weeds, shade ground	Low

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Figure 2. Diagram of peanuts and watermelons planted in a row intercropping system.

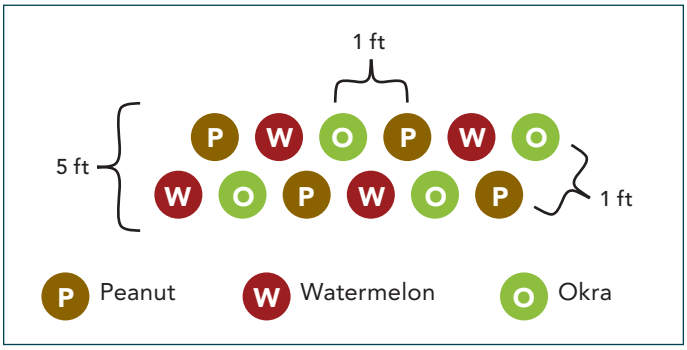


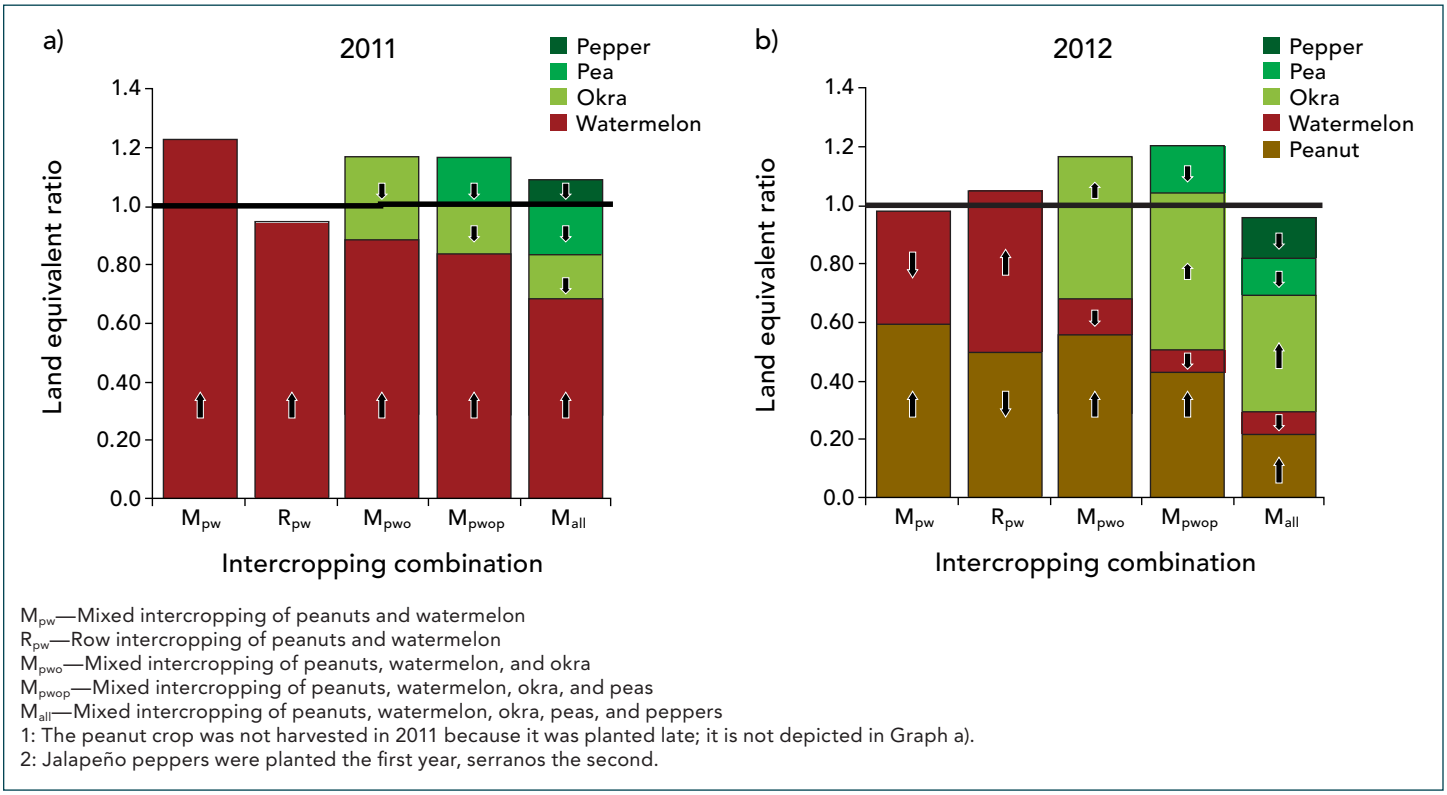
Figure 3. Diagram of the mixed intercropping system used in the Texas A&M study, in which plants of different species were alternated in each row.

The researchers weighed the vegetables harvested and calculated the yields per plant and per land unit area. They then compared the yields from species planted monoculture and those intercropped.

Planting three or four species together consistently yielded more per land unit than did those crops grown alone (Fig. 4):

- **Four of the five** intercropping combinations produced more pounds per land unit than did those crops planted monoculture in Year 1.
- **Three of the five** intercropping combinations produced more pounds per land unit than did those crops planted monoculture in Year 2.
- **Watermelon** yields benefited most from intercropping in Year 1.
- **Okra** and **peanut** yields benefited most in the second year.

However, peppers and peas produced less than expected both years, regardless of intercropping combination. Yield from the other crops varied in production by treatment and by year (Table 2).



M_{pw}—Mixed intercropping of peanuts and watermelon
R_{pw}—Row intercropping of peanuts and watermelon
M_{pwo}—Mixed intercropping of peanuts, watermelon, and okra
M_{pwop}—Mixed intercropping of peanuts, watermelon, okra, and peas
M_{all}—Mixed intercropping of peanuts, watermelon, okra, peas, and peppers
1: The peanut crop was not harvested in 2011 because it was planted late; it is not depicted in Graph a).
2: Jalapeño peppers were planted the first year, serranos the second.

Figure 4. Land equivalent ratios, or the yield of each species intercropped compared to its yield when grown alone, from intercrops in a) 2011 and b) 2012. Values of more than 1 indicate an increase in overall combined crop yield per land unit. Arrows pointing upward indicate that the crop performed better than expected given the number of species in the mix; downward arrows indicate that the crop produced less than expected.

The researchers planted the crops on different dates to prevent the fast-growing species from crowding out those that grow more slowly. The pepper plants were transplanted into the garden at 3 inches tall; for other crops, seeds were planted directly in the ground *(direct seeded)* where they would mature.

Year 1:

- August 1: Peanuts
- August 7: Watermelon
- August 14 and 15: Okra and peas
- August 18: Peppers

Year 2:

- June 21 and 22: Peanuts and okra
- June 27: Peas
- July 3: Peppers
- July 12: Watermelon

Conclusion and considerations

Texas A&M researchers showed that intercropping three or four crops produced the most on a per-land-unit basis, despite changes in relative planting dates between the 2 years.

Vegetable producers and home gardeners thinking about practicing this type of intercropping should keep in mind the growth rates and competitive nature of the crops they choose, and select planting dates based on this information.

For example, because peanuts grow more slowly than do watermelons, growers should plant peanuts first and give them time to emerge before planting watermelons.

Another guide to determining relative planting dates is to choose which crop's production to maximize

Table 2. Yields per plant from interplanted crops and from those crops planted in separate plots (monoculture)

Crop combination	Crop	2011 yield per plant (lb)		% change	2012 yield per plant (lb)		% change
		Intercropped	Monoculture		Intercropped	Monoculture	
 Row intercrop	Peanuts[1]	—	—	—	0.13	0.15	–13.33
	Watermelon	4.25	4.61	–7.81	2.09	1.90	+10.00
 Mixed intercrop	Peanuts[1]	—	—	—	0.18	0.15	+20.00
	Watermelon	5.38	4.61	+16.70	1.48	1.90	–22.11
 Mixed intercrop	Peanuts[1]	—	—	—	0.22	0.15	+46.67
	Watermelon	8.14	4.61	+76.57	0.66	1.90	–65.26
	Okra	0.18	0.33	–45.45	3.66	2.49	+46.99
 Mixed intercrop	Peanuts[1]	—	—	—	0.24	0.15	+60.00
	Watermelon	11.31	4.61	+145.34	0.55	1.90	–71.05
	Okra	0.18	0.33	–45.45	5.42	2.49	+117.67
	Peas	0.02	0.04	–50.00	0.04	0.04	0
 Mixed intercrop	Peanuts[1]	—	—	—	0.15	0.15	0
	Watermelon	12.13	4.61	+163.12	0.66	1.90	–65.26
	Okra	0.20	0.33	–39.39	5.03	2.49	+102.01
	Peas	0.04	0.04	0	0.04	0.04	0
	Peppers[2]	0.02	0.11	–81.82	0.15	0.35	–57.14

1: Peanuts were not harvested the first year because they were planted too late.
2: Jalapeño peppers were planted the first year, serranos the second.

the most. If you want to maximize watermelon production, plant it earlier than the other component crops.

Those wishing to intercrop should also leave enough space between plants to avoid overcrowding but not so much that the plants cannot benefit each other. A good way to determine how to close to plant species of different spacing requirements is to use the average recommended plant spacing of all of the crops used.

With this strategy, you may plant some crops slightly closer than recommended and other crops with slightly farther apart. However, most should fall within an acceptable range.

Other options are to use companion crops that have similar spacing requirements to avoid overcrowding or to select varieties that tolerate tight spacing. For instance, the study used a mini watermelon variety because it required half the spacing of a standard sized watermelon—1.5 feet versus 3 feet apart.

Intercropping diverse species where each performs a specific function in the garden can lead to overall yield increases per unit area and per plant. This technique can enable home gardeners and vegetable producers with limited space to maximize the overall productivity of their land.

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