ENVIRONMENTAL SCIENCE JOURNAL FOR KIDS

JANUARY 2024

What are the benefits of growing multiple crop species together?

Researchers:
Chunjie Li, Tjeerd-Jan Stomph, David Makowski, Wopke van der Werf and others
Associate Editors:
Allison Gamzon and Alexandra Appleton

Abstract

LOWER READING LEVEL

Did you know there are different ways to grow food? Two ways are sole cropping and intercropping. Farmers sole crop when they plant a field with only one crop. Farmers intercrop when they plant two or more crops in the same field. We wanted to compare sole cropping and intercropping. We found that intercropping produces less of each type of crop on a field. But intercropping produces more food choices. It also can save land space and reduce the amount of fertilizer needed to grow food. That is why intercropping is an important method for farmers to consider using in the future.

Introduction

Farmers grow a lot of the food you eat. Farmers have two main goals. The first goal is to grow enough food to meet the needs of a growing population. The second goal is to grow this food in a **sustainable** way. How can farmers grow large amounts of food without using too many natural resources? There are two main methods: **sole cropping** and **intercropping**. Sole cropping is when only one plant species grows in a field. Intercropping is when two or more plant species are grown in the same field at the same time. During intercropping, a grain crop and a **legume** crop are often grown together.

Intercropping increases crop **diversity**. Crop diversity can protect fields from **pests**, diseases, and weeds. For example, if one plant becomes infected with a pest, it can spread to plants of the same species. With intercropping, the mixture of plants prevents the pest from spreading. Intercropping can also affect the amount of fertilizer used by a farm. Using less fertilizer is important. Then the farmer needs to use fewer resources. So, it lowers the cost of growing the food. Lower fertilizer use can also reduce the amount of **nitrogen pollution** in rivers and the ocean.

Most farmers use sole cropping, not intercropping. We wanted to compare these two farming methods. Our goal was to provide information to farmers and policy makers. We used the results of field experiments to compare these two methods.

Corn (maize) is the most widely cultivated grain in the world. People can eat it directly, but also use it for animal feed, corn starch, corn syrup, and biofuels.
Photo: Frank Meriño on Pexels.

Methods

We analyzed a global set of data. It included the results of over two hundred experiments. These experiments investigated intercrops that included a grain and another crop type. The second crop was either a legume or **oilseed** crop. We focused on experiments that used the same methods to grow the intercrop and the sole crop.

From the experiments, we worked out several things:

1. the amount of grain that could grow on a field,
2. how much grain could grow on the same field with a second crop,
3. how much nitrogen fertilizer the fields needed, and finally
4. **land use efficiency** and **protein content**.

Results

Intercropping produces less grain than sole cropping. Imagine two identical fields. A farmer plants only corn (**maize**) on Field 1. The farmer plants Field 2 with half corn and half soybeans. At the end of the growing season, Field 1 produces 10 tons of corn. Field 2 only produces 8 tons.

But intercropping produces more food than sole cropping. (Fig. 1). Imagine our farmer needs to grow both corn and soybeans. To do that, the farmer can plant Field 1 with corn and Field 2 with soybeans. If they do, they get 10 tons of corn and 4 tons of soybeans. But the farmer could also plant both fields half with corn and half with soybeans. If they do, they get 16 tons of corn and 4 tons of legumes.That is a total of 20 tons, compared to 14!

We also found that intercropping requires less nitrogen fertilizer. It also produces either the same amount or a higher amount of protein.

How much more food does intercropping produce compared to sole cropping?

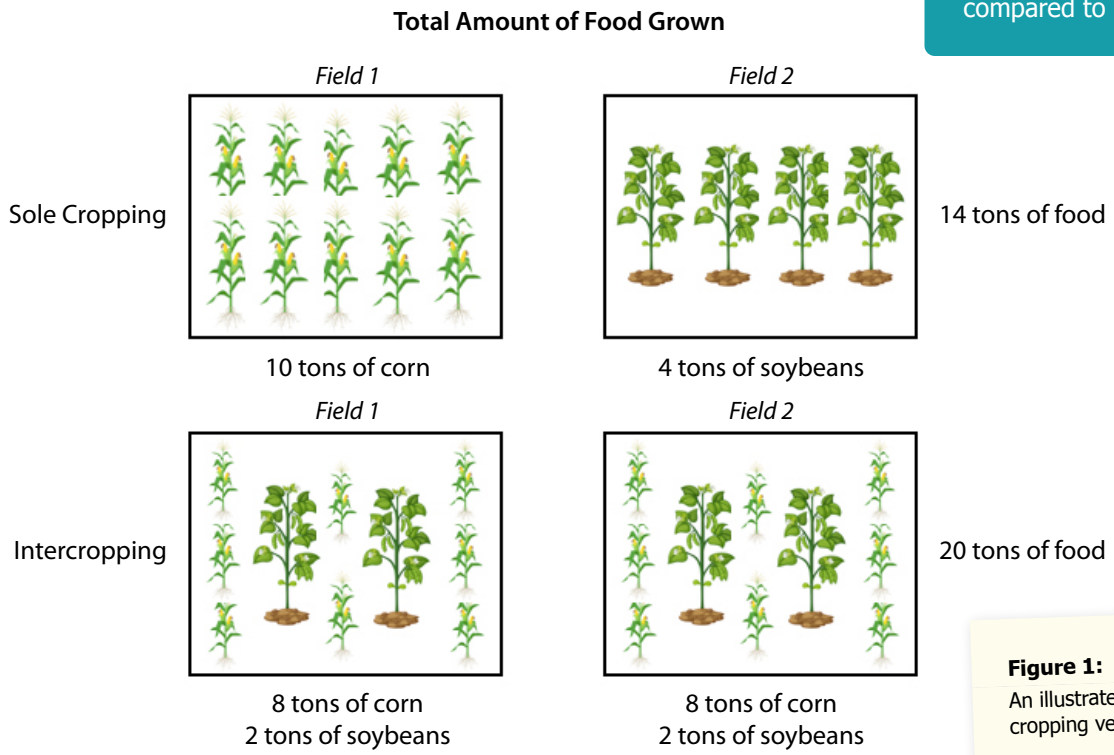

Figure 1:
An illustrated comparison of sole cropping versus intercropping.

Discussion

Is intercropping the best farming method? The answer to this question depends on the goal of the farmer. If the goal is to produce the largest amount of a single crop, then sole cropping is the better method. If the goal is to produce many types of food, then intercropping is the better method. With intercropping, farmers cannot grow as much of each individual crop. But, by growing two crops together, the land produces many food types.

Intercropping can also increase land **productivity**. If a farmer plants a field with half corn and half soybeans, we expect to grow half as much of each. Think back to Field 1 and Field 2. If the farmer uses intercropping, we predict that 5 tons of corn and 2 tons of soybeans will grow. But, the farmer actually grew 8 tons of corn and 2 tons of soybeans. Why? The corn and soybeans grow in alternating rows. Growing the different plants next to each other helps them grow better. That's because each crop has different needs. A corn plant growing next to another corn plant will fight over the resources it needs to grow. It doesn't have to fight as much next to a soybean plant.

We also learned that intercropping often decreases nitrogen fertilizer use. That means intercropping is a more sustainable practice. It reduces the amount of resources needed to grow food. It also helps reduce the impact of farming on the environment. Nitrogen fertilizer is a common water pollutant. Less fertilizer use means less nitrogen enters rivers and the ocean.

Our research showed that intercropping is a good choice for farmers. We found that there are many benefits to intercropping. That is why farmers need to think about using this method in the future.

Conclusion

Intercropping is an example of how important diversity is to an ecosystem. The more diverse an area, the more able it is to survive disease, pests, and extreme weather events. You can help keep your local ecosystem stable. Try planting a diverse set of plants in your yard or garden. This diversity can maintain the health of the soil. It can provide habitats for many organisms, such as insects and birds. Which plants are best to grow in your area? Do some research or ask for guidance when purchasing plants to grow in your yard or garden.

REFERENCES

Chunjie Li, Tjeerd-Jan Stomph, David Makowski, Haigang Li, Chaochun Zhang, Fusuo Zhang, and Wopke van der Werf (2022) *The Productive Performance of Intercropping.* PNAS: Agricultural Science and Sustainability Science.
https://www.pnas.org/doi/10.1073/pnas.2201886120

United Nations Environment Programme (2021): A Beginner's Guide to Sustainable Farming.
https://www.unep.org/news-and-stories/story/beginners-guide-sustainable-farming

National Geographic: The Art and Science of Agriculture.
https://education.nationalgeographic.org/resource/agriculture/

Acknowledgment: This article's adaptation was supported by the Moderna Charitable Foundation.

Glossary of Key Terms

Diversity - the state of having more than one type of something.

Intercropping - the farming practice of growing two or more crop species in a field at the same time.

Legumes - family of flowering plants that produce protein-rich edible seeds. Crop species include lentils, peas, broad beans, chickpeas, soybeans, common beans, lima beans, and peanuts.

Land use efficiency - a measurement of how much crop can be grown per unit of land. A more efficient method produces more crop on a small amount of land.

Maize - the agricultural term used for corn.

Nitrogen pollution - when too much nitrogen is washed off the land and carried to rivers, lakes, and the ocean. Too much nitrogen causes large amounts of algae to grow. The breakdown of this extra algae lowers oxygen levels in rivers, lakes, and the ocean. Lower oxygen levels cause fish and other animals to die.

Oilseed crop - a crop grown to produce oil. Examples include soybeans, cottonseed, sunflower seed, canola, rapeseed, and peanuts.

Pest - an insect or other small animal that damages crops.

Productivity - the ability of the land to grow crops.

Protein content - the amount of protein a food contains. Protein is a main component of a healthy diet. Proteins are used to build muscle, bone, and skin. They are needed to keep the body healthy.

Sole cropping - the agricultural practice of growing only one crop species in a field at the same time.

Sustainable - avoiding an overuse of natural resources so that a practice can continue into the future.

Check your understanding

1. How does the amount of grain farmers can grow using sole cropping compare to the amount of grain they can grow using intercropping?

2. What are three benefits of intercropping?

3. Why is this research important for farmers and policy makers?

4. Farmers must know the needs of the crops before they decide to intercrop them. With a partner, brainstorm at least two needs of a crop like corn or soybeans that farmers need to know before planting them.

5. Write a letter to a local farmer persuading them to use intercropping on their farm. Make sure to include evidence and reasoning to support your argument.