FROM FIELD TO FORK

Global Food Security
Sustainable, healthy food for all

Producing Food

How many ways can we grow wheat?

John Innes Centre

Wheat is a member of the grass family and provides more nourishment for more people worldwide than any other food. In developed nations wheat provides 40–60% of the calories in people's diet. More foods are made from wheat than any other grain. 100 kilos of wheat contain 2 million grains, enough to make 100 loaves. Only wheat contains enough gluten to make raised or leavened bread. In 2006, about 614 million tonnes of wheat were produced worldwide covering an area nine times the size of the UK.

Demand for food is expected to increase by 40% by 2030, but the amount of land suitable for food production is likely to decrease. Between March 2007 and March 2008, the price of wheat rose by 130%. In South America, the 2008 wheat production was halved by drought in Argentina, and persistent dry weather continued to affect the 2009 grain harvest in the region.

The loss of suitable land for food production is due to climate change and other uses for the land. Drought, salt water, flooding, high temperatures, pests and disease are making it harder for farmers to produce enough wheat, so scientists are carrying out research to help farmers achieve the sustainable production of sufficient, safe, nutritious and affordable food to supply the world's growing population.

To produce enough food for a population of 9 billion people expected by 2050 plant breeders need to apply new knowledge from crop genetics and fundamental biology. Conventional breeding cannot deliver the rate of yield improvement seen in the past but genetic variation can be used to improve the features of plants that improve crop yield.

FURTHER INFORMATION

For more information about wheat visit **www.allaboutwheat.info**

Activity

How can scientists carry out an experiment to find out which is the best new wheat to grow with which fertiliser?

The problem is how to test each new wheat variety with each fertiliser! Since 1843, researchers at Rothamsted Research have improved food production by comparing cereal growth in blocks treated, or not treated, with fertiliser.

The scientists need to plant four varieties of wheat and test them with four different fertilisers. The scientists have a plot of four by four blocks to grow the wheat.

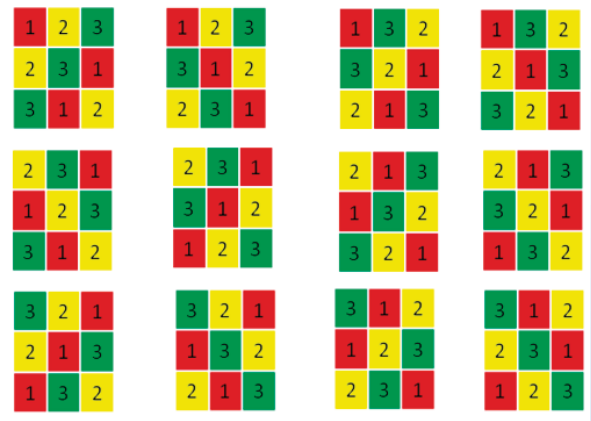
How many different ways could they organise the experiment?

Helpful Hints

With three varieties of wheat there are 12 ways of planting them, with only one variety in each column or row.

This layout is known as a Latin square and is used to design field trials. Solutions to Sudoku puzzles are Latin squares.

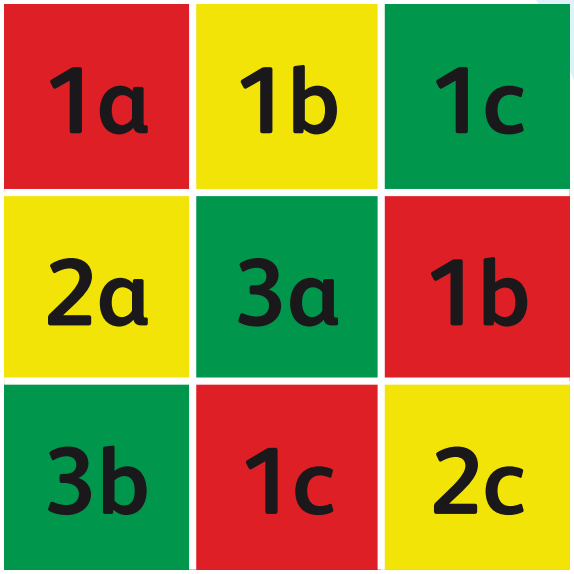
Each wheat variety is given a number and colour to help you see all the different ways they can be arranged. **1** (red), **2** (yellow) and **3** (green).



But how many are really different?

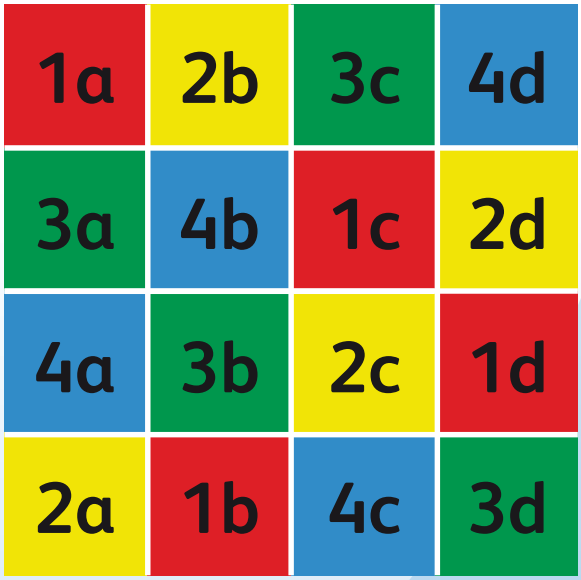
Can you rotate or flip some to produce the same pattern?

With three varieties of wheat and three varieties of fertiliser can you make sure each wheat variety is tested with each fertiliser?



How many ways can you arrange the wheat plots?

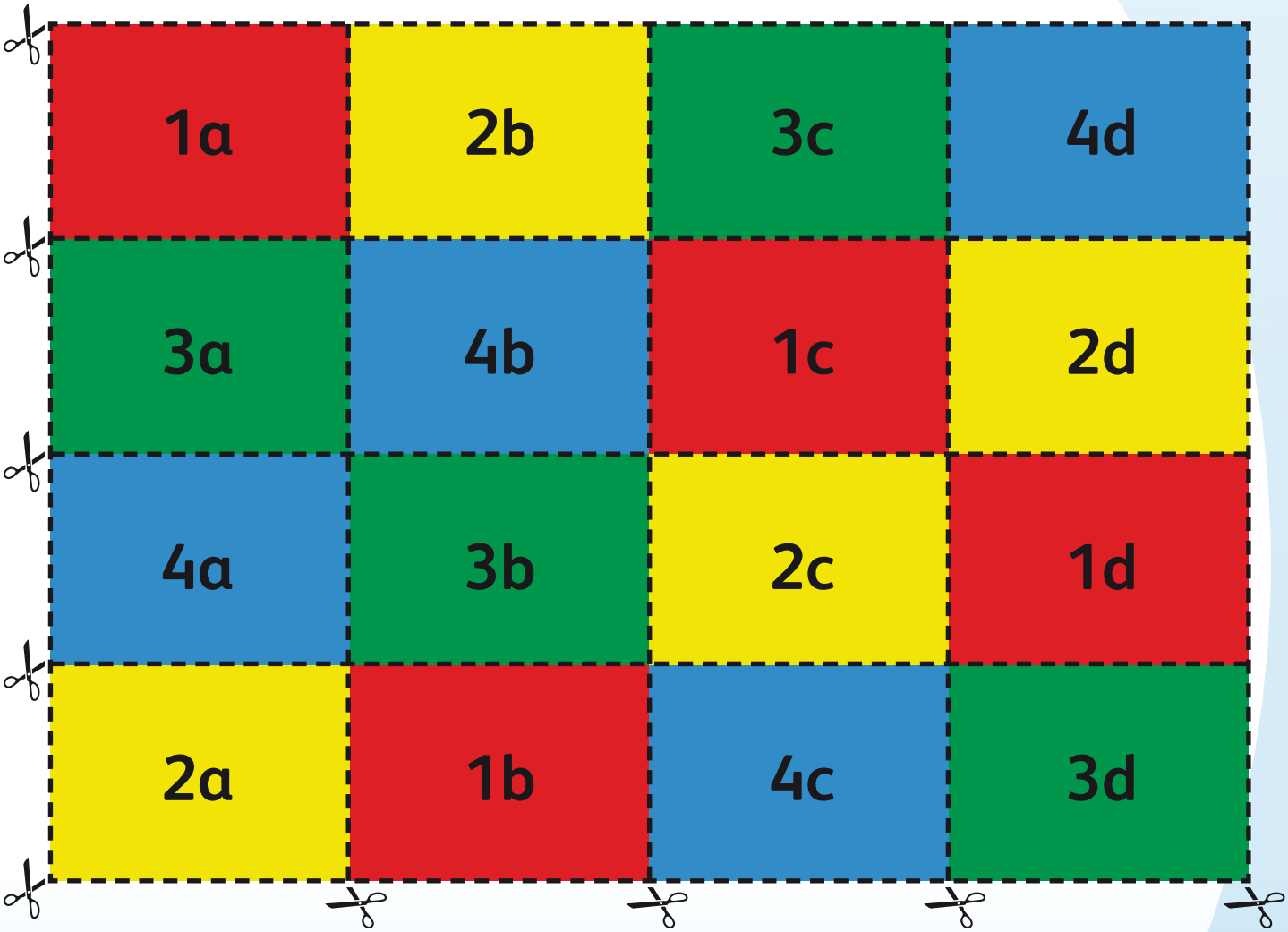
Give the fertiliser's letters to help you. These are known as Graeco-Latin squares.



With four varieties of wheat and four fertilisers how many unique ways can you arrange them?

Use the cut-out sheet to give it a try.

CUT OUT SHEET



With four varieties of wheat and four fertilisers how many unique ways can you arrange them?

Use the cut-out sheet to give it a try. (Answer on the back)

ANSWER - 144 without rotations or reflections