

WATER EXTRACTION BY ROTATION CROPS

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A major benefit from the use of rotation crops, such as wheat, is thought to be an improvement in soil structure due to the drying and cracking of the soil. Legume rotation crops, such as field peas or Dolichos lab lab, fix atmospheric nitrogen and reduce the amount of fertiliser nitrogen required by subsequent cotton crops.

Improvements in soil structure due to wheat and safflower have been documented by Hulme et al. (1991), but the benefits from other crops, especially legumes, has not been investigated. Nor has the effect of different management strategies for the wheat crop been investigated.

In 1993 a series of experiments were established in the Namoi and Macquarie valleys to study the effects and benefits of rotation crops for subsequent cotton crops. The results presented here, are the effects of 4 different rotations on soil moisture, in the Macquarie valley, during the 1993 season.

TREATMENTS AND MEASUREMENTS

The trial has 7 treatments in total, but during the 1993 winter season only 4 treatments had commenced. Background information for each of these treatments is listed below.

1. **Long Fallow** - stubble from the 1992-93 cotton crop was slashed and the area left bare until the next cotton crop in 1994-95.
2. **Winter Legume** - Field peas were direct seeded into standing cotton

stubble on 17 June (seed rate 102 kg/ha, 85 kg/ha of DAP fertiliser). Approximately one month later the cotton stubble was slashed. In mid October the field peas were killed by spraying with Roundup and subsequently (late December) incorporated as green manure.

3. Wheat Low Input - Janz wheat was direct seeded into standing cotton stubble on 18 June (seed rate 40 kg/ha, 85 kg/ha of DAP fertiliser applied with the seed). Approximately one month later the cotton stubble was slashed.

4. Wheat High Input - Janz wheat was direct seeded into standing cotton stubble on 18 June (seed rate 106 kg/ha, 85 kg/ha of DAP fertiliser applied with the seed, 180 kg/ha of urea broadcast just prior to sowing). Approximately one month later the cotton stubble was slashed. This treatment received 1 irrigation in early September.

Soil moisture

Three neutron probe access tubes were installed in each plot in August and regular readings with a neutron moisture meter commenced on 1 September. From the neutron probe readings we calculated soil moisture (%) at 20, 40, 60, 80, and 100 cm depth, plus the total moisture in the profile (mm) from 10 to 110 cm depth.

RESULTS

Wheat - High and Low Input

Of all the treatments studied, low input wheat with no spring irrigation dried the soil the most, especially late in the season (Fig. 1). However, when soil moisture measurements commenced on 1 September, high input wheat had the driest profile (Fig. 3). This is because the high input wheat was the most vigorous crop and

FIGURE 1. Total soil moisture (mm) in the 10-110 cm zone under 4 rotation crops, and rainfall, in the Macquarie Valley in 1993. (Wheat L = low input wheat, Wheat H = high input wheat)

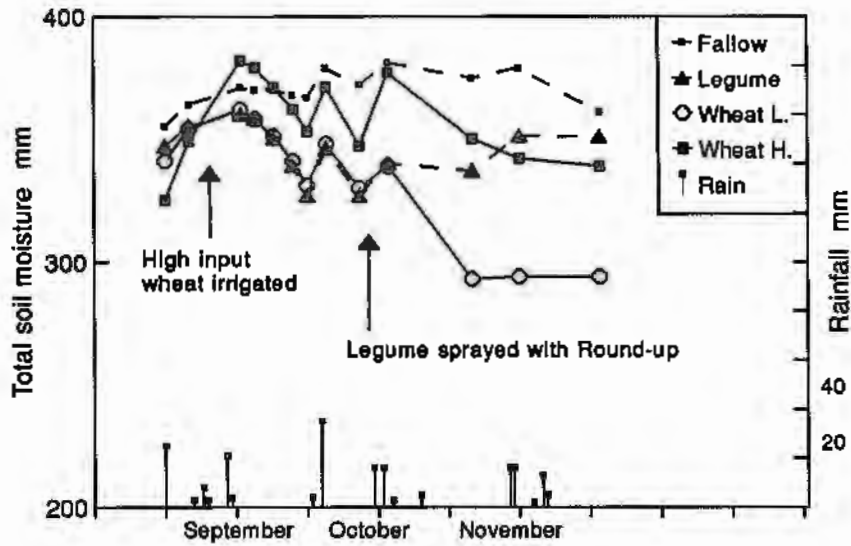


FIGURE 2. Dry matter yield of a legume (field peas), low input and high input wheat, in the Macquarie Valley in 1993.

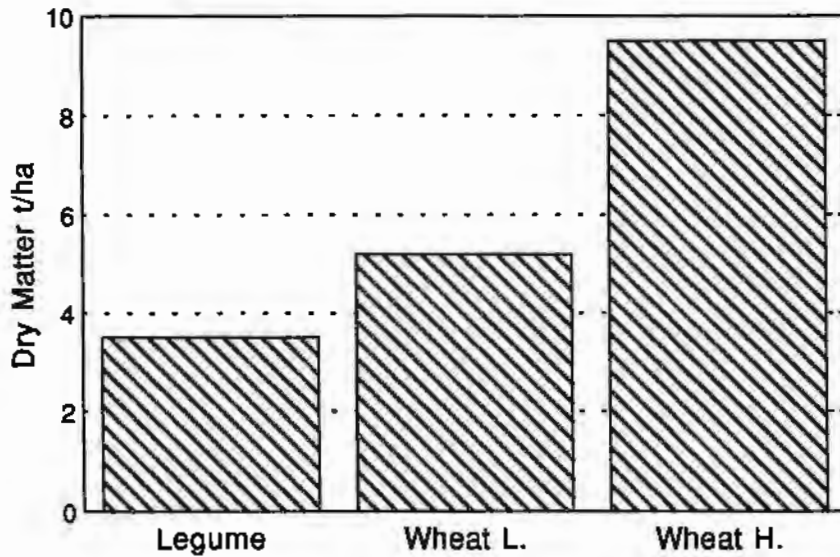


FIGURE 3. Soil moisture profile of 4 rotation treatments in the Macquarie Valley, 1 September, 1993.

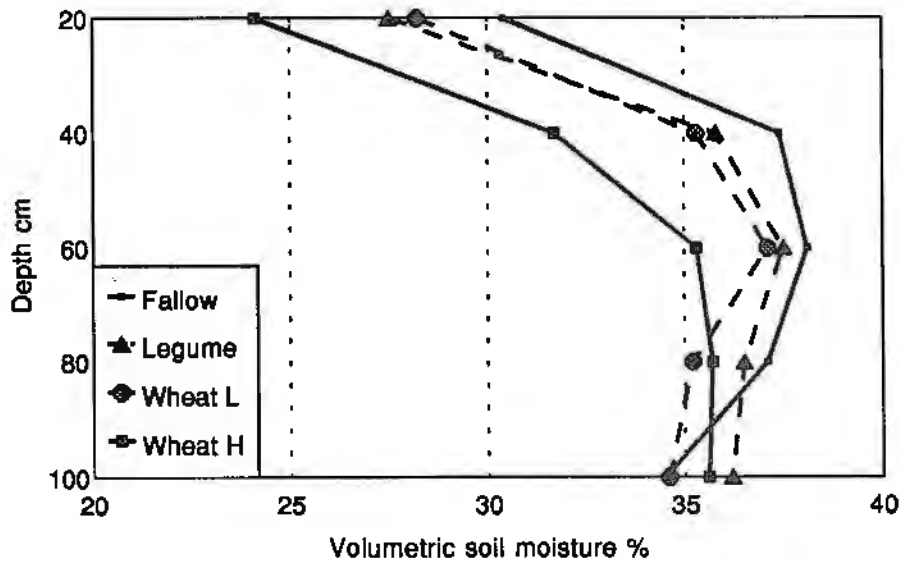
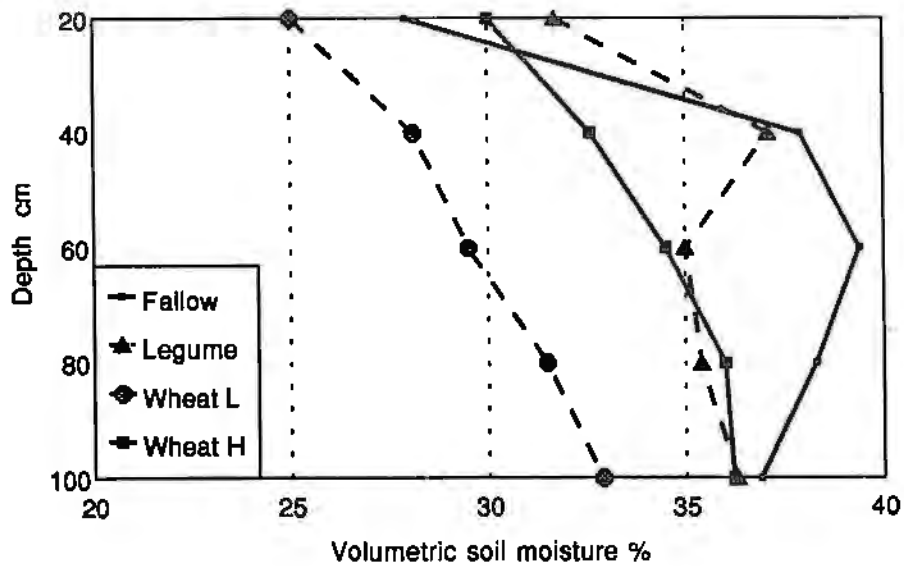


FIGURE 4. Soil moisture profile of 4 rotation treatments in the Macquarie Valley, 2 December, 1993.



produced the most dry matter of any treatment (Fig. 2), hence it used the most water.

Once the high input wheat was irrigated in early September, the soil moisture never came back down to that of the low input wheat, although it did continue to extract moisture for longer than the low input wheat. Spring rainfall for the Macquarie Valley in 1993 was almost double the long term average, and in a drier season the final soil moisture content under high and low input wheat would be much closer.

As well as extracting the most moisture from the soil, the low input wheat dried the soil to the greatest depth (Fig. 4). On 2 December the low input wheat had the lowest soil moisture (%) at all depths down to 100 cm.

Winter Legume

Up until they were killed in mid October (by spraying with Round-up), soil moisture under the field peas was similar to that of low input wheat. During November this treatment gained moisture because there were several heavy falls of rain and the mat of dry plant material minimised surface evaporation.

The plants were not taken through to maturity because it is usually very difficult to harvest field peas grown on hills. Also the treatment was equivalent to a green manure crop which is how field peas are often used in the Macquarie Valley.

The soil moisture data are encouraging for the use of field peas as a green manure crop. Up until November, peas were just as good as wheat at drying the profile, and they have the potential to improve soil fertility by fixing atmospheric

nitrogen.

Long Fallow

This treatment actually gained moisture during the season. As this treatment shows, very little moisture is lost from bare soil below about 20 cm, no matter how hot or dry the conditions.

CONCLUSIONS

Wheat with no spring irrigation is a very effective means of drying the soil but legumes can be just as good.

REFERENCES

Hulme, P.J., McKenzie, D.C., Abbott, T.S. and MacLeod, D.A. (1991) Changes in the physical properties of a Vertisol following an irrigation of cotton as influenced by the previous crop. *Aust. J. Soil Res.* **29**, 425-42.

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