Demonstration of organic crop production at Rutherglen, north-east Victoria

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ABSTRACT

An organic farming demonstration site was established on nine hectares at Rutherglen Research Institute in 1994 to investigate organic production strategies for broadacre producers. The site has an average annual rainfall of 600 mm and the main soil types are Chromosols and Dermosols. The demonstration site is managed by a committee comprising organic producers, agronomists and organic industry representatives to organic standards set by the National Association for Sustainable Agriculture, Australia (NASAA). Results from five years of crop production in rotation show that cereal yields can be improved with increased seeding rates (76 - 100 % greater than conventional rates). Analyses of soil collected over summer shows levels of available phosphorus (P) have not changed since 1994 with the addition of less-soluble forms of P fertiliser. The addition of lime as calcium carbonate in 1999 raised pH ($CaCl_2$) from 4.4 to 4.9 in the 0-100 mm soil depth after 12 months, with no substantial increase in soil organic matter.

KEY WORDS

Organic farming, cereal crops, grain yield, soil phosphorus, soil pH, soil organic matter.

INTRODUCTION

World trade in organic produce has been growing at about 20% per annum over the last five years and organic foods are reported to be the fastest growing sector of food markets in the US, Japan and many European countries (4). Currently there is insufficient supply of certified organic product in Australia to meet export demand. The Organic Demonstration Site at Rutherglen Research Institute was established to provide information on organic methods of crop production to producers who want to convert to certified organic farming and supply this expanding market. The site is managed to the standards set by the National Association for Sustainable Agriculture Australia (NASAA). The major constraints in growing cereal crops organically are managing the weed competition, particularly annual ryegrass, and maintaining soil fertility, particularly phosphorus (P) and nitrogen (N) supplies. Cereal crops have been established each year on the site by seeding into either uncultivated (direct drill) or cultivated seed-beds with a range of seeding and fertiliser rates, to achieve desired crop densities and suppress weed competition. Measurements included soil chemical analyses, and crop yield and quality.

RESULTS AND DISCUSSION

Five years of crop production from the site has demonstrated that cereal yields can be increased when higher sowing rates are used (Table 1). Where wheat, barley and oats were established without pre-sowing cultivation to reduce weeds (1999), yields were greater with higher seeding rates (Table 1). The different competitive abilities of crop species during establishment may have contributed to the measured yield variations, with oats being generally more suppressive of annual ryegrass than either wheat or barley (3). Given that soil cultivation to control weeds can have detrimental effects on the structure of some soils (1), the use of competitive crops, and the management of weed seed banks in the pasture phase, are critical factors for successful organic crop production.

Soils collected each summer have shown no significant decline in available P (Table 2). Although there was no comparative control treatment (for example, a soluble form of P added at the same rate) we consider that the less soluble forms of P (reactive phosphate rock (RPR), or Vicmill PSK™, or Vicmill COF™) used on the site have helped maintain soil P levels. The pH ($CaCl_2$) has increased (10%) with the addition of liming material in 1999 to give a site average of 4.9, but there has not been any significant change in the site’s organic matter status over five years of organic production (Table 2). The maintenance of adequate levels of available soil P in organic farming systems is critical for crop production as organic standards do not allow the use of synthetic fertilisers such as superphosphate, and as Australian soils are generally low in available P. The effect of organic farming systems on available soil P has been studied in South Australia (5). This trial was established on alkaline soil in a 440 mm rainfall environment and demonstrated a decline in available P in both organic and biodynamic treatments. After five years of organic production at the Rutherglen site, a decline in available P has not been shown. This is most likely due to the combination of acidic soils and a higher rainfall, which facilitate the conversion of P in reactive phosphate rock to plant-available forms during the growing season (6).

Table 1. Grain production from the cereal phase of the rotation, 1995 - 1999.

Year	Crop cultivar	Establishment method[A]	Sowing rate (kg/ha)	Yield (t/ha)	Protein (%)
1995	Wheat Katunga	C	100	5.3[B]	NA
1996	Wheat Katunga	C	150	1.2	9.9
1997	Wheat Dollarbird	C	175	3.4	9.4
1998	Triticale Maiden	C	170	0.25[C]	14.9
1999	Wheat Rosella	DD	85	0.5[D]	11.7
1999	Wheat Rosella	DD	170	1.1[D]	13.0
1999	Wheat Silverstar	DD	85	0.6[D]	12.4
1999	Wheat Silverstar	DD	170	0.7[D]	11.2
1999	Barley Picola	DD	85	1.0	10.4
1999	Barley Picola	DD	170	1.4	9.5
1999	Oats Quoll	DD	85	1.3	11.2
1999	Oats Quoll	DD	170	2.1	12.0

[A] C = cultivated seed-bed; DD = direct drill
[B] harvested as hay due to high ryegrass infestation (144 roles @110 kg/roll).
[C] severely affected by frost.
[D] frost affected.
NA = not analysed

Table 2. Soil chemical analyses for the Organic Demonstration Site (average of three blocks ? s.e.) for the period 1995 to 2000.

Year	Available P ppm (0-100 mm)	pH ($CaCl_2$) (0-100 mm)	Organic matter (%)
1995	13.1 ? 1.3	4.4 ? 0.03	2.3 ? 0.57
1998	11.2 ? 0.2	4.8 ? 0.12	4.0 ? 0.26
2000	16.0 ? 0.8	4.9 ? 0.14	3.0 ? 0.15

CONCLUSION

The Organic Demonstration Site has shown that crop yields can be improved in organic farming systems with higher seeding rates, and with attention to weed management and soil fertility. Levels of available P can be maintained because reactive phosphate rock is an effective source of P for our soils and rainfall, but longer term replicated monitoring of this farming system is needed to accurately determine crop yields and nutrient budgets.

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