On-Farm Surveys of Organic Farm Practice in Ontario

Karen Maitland and E. Ann Clark; Plant Agriculture, University of Guelph

OBJECTIVES

How effectively do organic practices maintain soil fertility and manage weed, insect, and pathogen problems to sustain commercial farming? What practices are employed? Are livestock a necessary complement to sustainable farming practice? How generalizable are findings from one farm to another?

MATERIALS AND METHODS

These questions were addressed in a 3-year survey of 10 to 13 farms per year, of which 2 were ecological and the remainder were certified organic. Farms were selected to enable contrasts between horticultural (hort) and field crop farms, and between those with and without access to livestock manure, using pasture farms as the soil control. Assessments were based on potato (spuds), carrot, and broccoli fields on hort farms, and spring grain, winter cereal, and soybean fields on field crop farms. Soil samples (a bulk of 20 cores per field) were collected in the fall, while weed samples were collected (10 to 20 quadrats per field) in midseason. Farmers annually completed questionnaires encompassing a range of agronomic issues.

RESULTS AND DISCUSSION

Soil Quality

Farm-year data are presented, using OMAF recommendations for cereals as the standard. Most or all farms met or exceeded the OMAF medium range for K and P, respectively, with no evidence of 'mining' the soil to support yield (Fig 1 and 2). Duration of organic farm practice averaged 9 years (range from 0 to 20) at the start of the study. Farms with access to livestock manure, including imported manure on hort farms, tended to have higher levels, with some in the excessive range.

Fig 1. Soil K over 75 site-years on farms with ( ) and without ( ) livestock manure

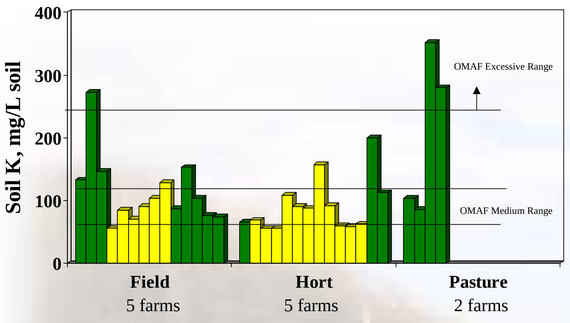


Fig 2. Soil P over 75 site-years on farms with ( ) and without ( ) livestock manure

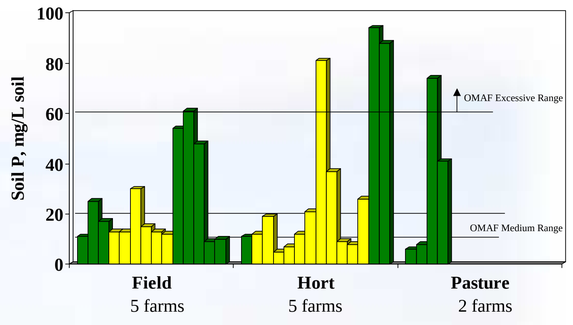
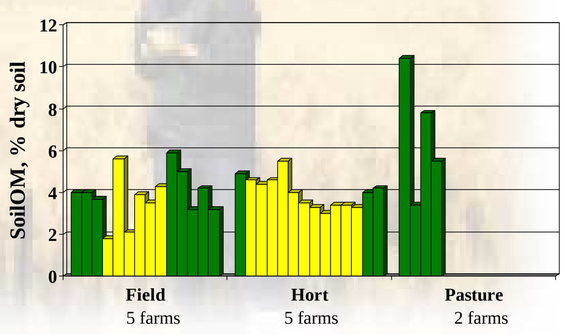


Fig 3. Soil OM over 75 site-years on farms with ( ) and without ( ) livestock manure

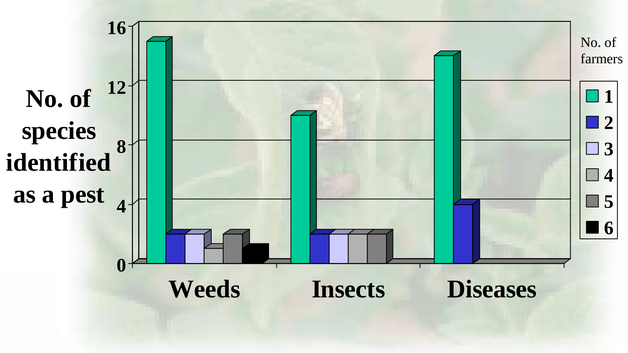


Soil organic matter (SOM) averaged 3.9% on both hort (range from 3.0 to 4.9) and field crop farms (range from 1.8 to 5.9), compared with 6.8% on the pasture farms (range from 3.4 to 10.4) (Fig 3).

Weeds

Problem species identified by farmers were largely different among farms (Fig 4), and between hort and crop farms (Fig 5). Fifteen of the 23 weed species identified as problematic were of concern on individual farms. Species identified by 2 or more farmers were dandelion and wild mustard (2), ragweed and bindweed (3), Canada thistle (4), quackgrass and lambsquarters (5), and pigweed (6)

Fig 4. Most pest species were site-specific



Based on quadrat sampling, 21 weed species each accounted for at least 1% of weed biomass. Thirteen of the 21 weed species differed significantly between field and hort crop farms, with 6 more prominent on hort farms (broad-leaved plantain, grassy weeds, lambsquarters, mustard, pale smartweed, and pigweed), while 7 were more prominent in field crop farms (alfalfa, bindweed, night-flowering catchfly, clovers, volunteer grasses, ragweed, and stinkweed).

Weed biomass varied among years in 4 of the 6 tested crop types (Fig 6), was greater on field crop than on hort farms in 2 of the 3 sampled years, and in the aggregate over years. In g DM m^{-2}, hort and field crop weed biomass averaged 28 vs. 30 in 2001 (ns), 10 vs. 48 in 2002 (***), and 10 vs. 36 in 2003 (***), resp. On average, weed biomass was twice as high on field crop as on hort crop farms, reflecting more frequent cultivation on the latter.

Fig 5. Prevalence of weed species in field vs. hort crop fields (31 vs. 33 site-years, resp)

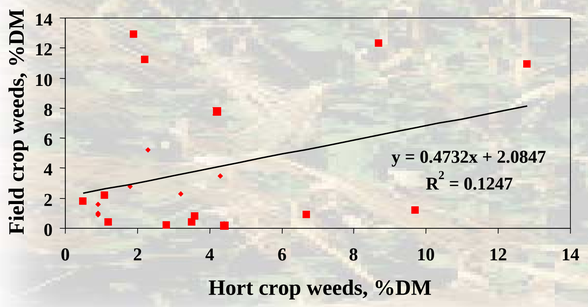
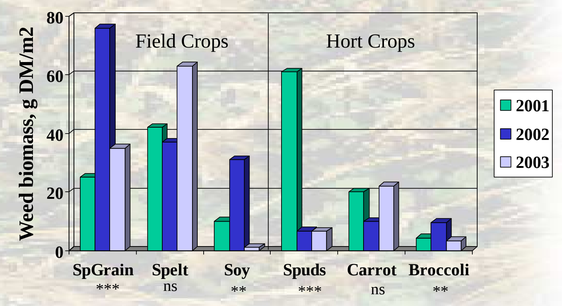


Fig 6. Weed biomass density at harvest in field and hort crops in 3 years



Farmers identified 18 insect species as problematic, but 10 were each identified only once (Fig 4). Species identified by more than 1 farmer were grubs and tarnished plant bug (2), cornborer and striped cucumber beetle (3), fleabeetle and Colorado potato beetle (4), and aphids and cabbage worms or loopers (5). Field crop farmers identified an average of 1.5 problematic insect species (range 0 to 3), compared with 5 (range 1 to 11) on hort farms. Only cornborer and soy aphid were identified on more than one field crop farm.

Pathogens

Of 18 problem diseases, 14 were identified as such only once (Fig 4). Species identified by 2 farmers were fusarium, downey mildew, rust (corn and oat), and tomato blight.

Almost all farmer-identified diseases were for hort crops, including apple scab and damping off in greenhouse seedlings. Field crop farmers identified an average of 1.2 diseases (range of 0 to 4), compared with an average of 2 diseases (range 0 to 8) on hort farms. On field crop farms, only fusarium (1 each for spelt and winter wheat) and corn rust were mentioned by more than 1 farmer.

Pests rated as 'out-of-control' by farmers included 7 weed, 6 insect, and 3 disease species, of which all but 3 weed species were so-identified by a single farmer each (Fig 7).

Crop Rotations and Ground Cover.

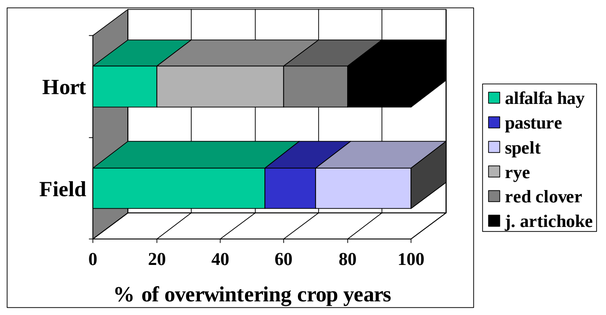
Crop rotation design is integral to pest management and maintenance of soil fertility and structure. Each farmer provided typical crop rotations for the various soil types on their farms. Crop rotations averaged 7 courses on both field crop (range 4-10) and hort crop (range 5-10) farms.

On average, the land was covered overwinter with living crops 42% of the time on hort farms (range 12 to 88%) and 64% of the time on field crop farms (range 40 to 100%). On hort farms, rye was the preferred overwintering crop, while on field crop farms, alfalfa hay accounted for just over half of the overwintering crop years (Fig 8).

Fig 7. Species rated as 'out-of-control' by 1 or 2 (of 12) farmers

- Weeds:
  ragweed
  plantain
  mustard
  jimson weed
  bindweed (2)
  pigweed (2)
  lambsquarters (2)
- Insects
  corn earworm
  soy aphids
  tarnished plant bug
  aster leafhopper
  striped cucumber beetle
  internal sheep parasites
- Diseases
  late blight of potatoes
  fusarium in wheat
  rust in corn

Fig 8. Overwintering crop species, by farm type



CONCLUSIONS

1.Soil fertility and organic matter are effectively maintained on organic hort and field crop farms in Ontario today. Livestock do not appear to be essential to soil fertility, and may result in excessive levels of K and P.

2.Weeds were more problematic than were insects or diseases on most farms. Insect and disease problems were of more concern on hort than on field crop farms, but weed biomass was twice as high on field crop as on hort farms - presumably due to more frequent cultivation on the latter.

3.Weed, insect, and disease issues, and out-of-control problems were quite site-specific, leading to few generalizable concerns. The suite of factors which allow a pest to proliferate appears to be sufficiently different on the various farms as to select for different pests, both within and between farm types.

4.Complex crop rotations, particularly those which keep the soil covered with living tissue overwinter, may contribute to effective soil management and pest control.

ACKNOWLEDGEMENTS

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