Poster 1225

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Cover Crop Mixtures May Reduce Nitrate Leaching and Fertilizer Application in Potato Production

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Introduction

- Potato consumption has been a major part of the North American diet since early in the 17th century.
- The need for more food and economic pressures have led to more intensive potato production systems and extensive use of fertilizers.
- Nitrogen (N) is one of the most limiting factors in potato production and farmers often over apply N to ensure against yield loss (Waddell et al., 1999).
- Up to 50% of the applied N can be lost through nitrate leaching, volatilization and de-nitrification.
- Over fertilization may increase costs of production and contamination of water recourses which threatens human health and sustainability.
- Management tools such as crop rotations with cover crops and tailoring N fertilizer application could be employed to sustain production and decrease environmental concerns.
- Cover crop mixtures can decrease nitrate percolation into water resources, provide nutrients for the following cash crops, increase soil organic matter, decrease nitrogen fertilization, and suppress weeds and diseases.

Objectives

- To study the effect of cover crop mixtures with different C:N ratios and N fertilizer rates on potato tuber yield.
- To evaluate the efficiency of cover crop mixtures on nitrate leaching in soil.

Materials and Methods

- A field experiment was conducted at the Crops and Animal Research Farm of the University of Massachusetts, South Deerfield in 2013 (The second year of the experiment is ongoing).
- The soil type was fine sandy loam (nonacid, mesic Typic Udifluvent) with pH of 6.5, organic matter content of 1.2%, N, P, K, and, Ca content of 3, 12, 76, and 834 mg kg^{-1}.
- Treatments were arranged in a randomized complete block design with four replications. Main plots consisted of cover crop mixtures and sub-plots were different N fertilizer rates.

Statistical analysis

- Analysis of variance (ANOVA) was conducted by PROC GLM procedures of SAS. The effect of nitrogen fertilizer was assessed by regression analysis. Duncan's New Multiple Range Test was conducted for comparison of means of cover crops.

Treatments

- Cover crop mixtures: Rye /Forage radish (R+FR), Oat/Forage radish (O+FR), Peas/Forage radish (P+FR), Rye/Peas (R+P), Oat/Peas (O+P), along with no cover crop (NCC) plots.
- Nitrogen fertilizer rates: 0, 50, 150, and 200 kg ha^{-1}.
- Potato variety: Dark Red Norland.

Field operations – Fall 2013

- Land preparation
- Planting cover crops
- Soil and cover crop tissue sampling

- Resin-based nitrate collector preparation

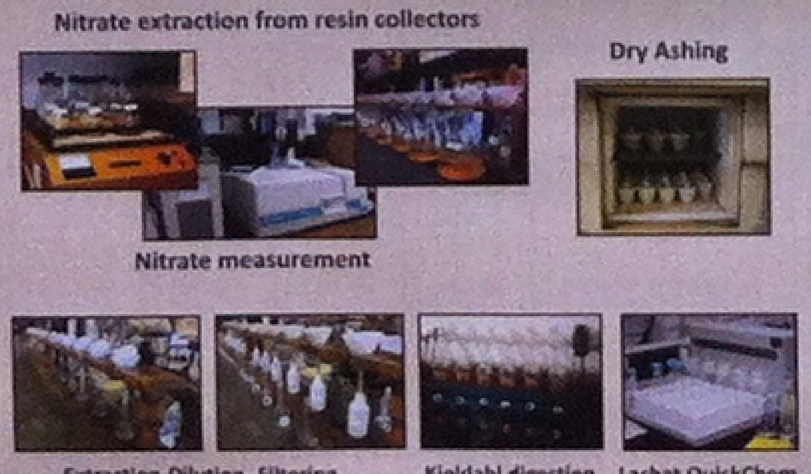
- Burying NO_3^- collectors prior to planting cover crops

Cover crop stands – Sep 26

Field operations – Summer 2014

- Disking cover crop residues - Planting potatoes
- Banding N fertilizer- Plant and soil sampling-Harvest

Sample analysis



Results

- Cover crop mixtures showed a significant difference compared with no cover crop plots in terms of potato tuber yield.
- While the highest level of N increased tuber yield in no cover crop plots, mixtures produced higher tuber yield at lower N rates (Fig. 1).
- The highest tuber yield was obtained from O+FR (25.8 Mg ha^{-1}) and O+P (26.1 Mg ha^{-1}) mixtures, fertilized at 100 kg N ha^{-1} (Fig. 1)
- Application of 150 kg N ha^{-1} decreased yield in O+FR and O+P plots compared to 100 kg N ha^{-1}.

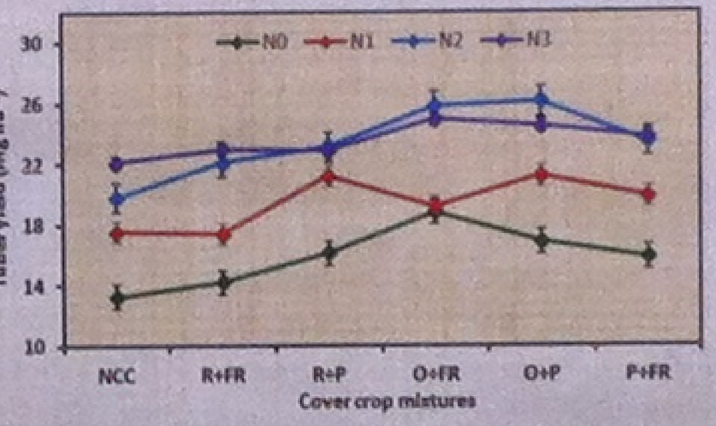


Fig 1. Effect of nitrogen fertilization and cover crop mixtures on potato tuber yield. N_0, N_1, N_2, and N_3 represent 0, 50, 100, and 150 kg N ha^{-1}.

- Oat/Forage radish mixture showed to be more efficient in providing nutrients for the following potatoes when no N fertilizer was applied (Fig. 1).
- Our results confirm those reported earlier by Vos and Van der Putten (2004) who found increased potato tuber yield when potatoes were planted after cover crops.

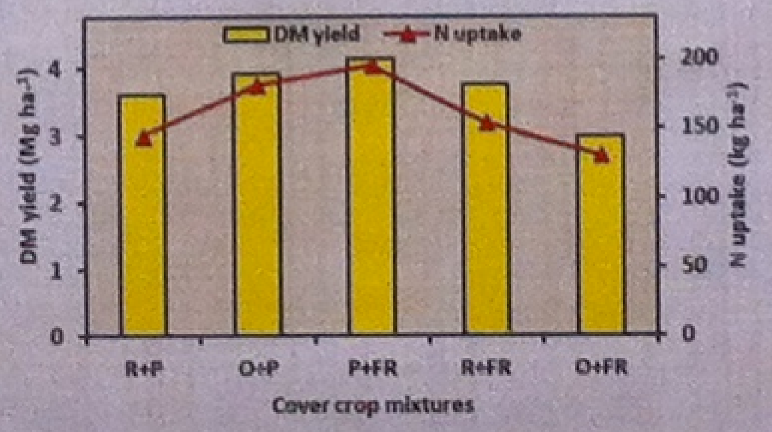


Fig. 2. Dry matter yield and nitrogen uptake at different cover crop mixtures.

- Peas/Forage radish mixture produced the highest biomass and dry matter (4.13 Mg ha^{-1}) among mixtures and the lowest DM yield was obtained from O+FR (Fig. 2).
- Nitrogen uptake followed the same trend as the DM yield and P+FR mixture had the highest N yield (195 kg ha^{-1}) followed by O+P (181 kg N ha^{-1}) (Fig. 2).
- Our results showed that cover crop mixtures reduced the amount of nitrate leached into the lower levels of the soil compared with no cover crop plots (Fig. 3).
- The highest amount of nitrate leachate was observed from no cover crop plots followed by P+FR mixture (Fig. 3).
- Nitrate leaching was minimum in R+FR mixture compared with other mixtures and there was not a significant difference between R+P and O+P mixtures.
- Meisinger and Delgado (2002) have also reported reduced nitrate leaching in soil by adding cover crops into a rotation.

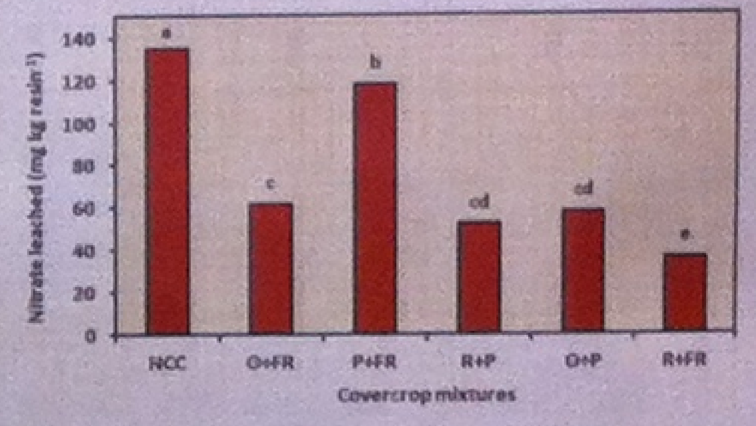


Fig. 3. Nitrate leaching as affected by cover crop mixtures.

Conclusions

- Cover crop mixtures may improve potato tuber yield and reduce nitrogen fertilizer application.
- Potatoes planted after O+FR or O+P produced higher yield at lower N rates compared with other mixtures.
- Less nitrate was leached into the soil if oat or rye were included in the mixtures compared to those were legume made a greater proportion of the mixture.

Acknowledgement

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References

- Meisinger, J.J and J.A., Delgado. 2002. Journal of Soil and Water Conservation, 57(6):485-498.
- Vos, J., and P., Van der Putten. 2004. Nutrient Cycling in Agroecosystems 70: 23–31.
- Waddell et al., 1999. Agronomy Journal. 91:991–997.

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INTRODUCTION

Manure application represents one of the most promising practices to reduce operation costs, reduce environmental impacts, and improve yields. With larger facilities for animal production and more regulated manure application guidelines, application options beyond Corn (*Zea mays* L.) for swine manure (*Sus scrofa* L.) are needed. Soybean (*Glycine max* L.) represents a good option for manure management as it is a high nitrogen (N) accumulator when compared to corn (4:1 ratio).

OBJECTIVES

- To determine the capacity of corn and soybean to manage N from swine manure applications.
- To compare the source of N (manure or UAN) effect on corn and soybean yield and N grain removal.

MATERIALS AND METHODS

Table 1. Site and Manure Characterization. ACRE and DPAC 2013.

	Soil (nutrients in mg kg^{-1})					Manure (kg 1000L^{-1})			
Location	pH	OM%	CEC	P	K	TKN	NH4-N	P	K
ACRE	6.4	3.6	18.3	26	123	1.9	1.8	0.2	2.0
DPAC	6.2	3.2	21.2	19	107	2.6	2.3	0.2	1.3

EXPERIMENTAL DESIGN:

Split plot design with two main plots: corn and soybean. Seven subplot treatments were swine manure (applied in fall 2012) at total N rates of ~112, 224, and 336 kg N ha^{-1} (Low, Medium and High); UAN (28-0-0) fertilizer (applied prior to planting) at rates that closely mirrored the swine manure; and an untreated control. Treatments were arranged in a RCBD with 3 replications per site.

PLOTS: ACRE 9.1 m x 96 m; DPAC: 9.1 m x 96 m

PREVIOUS CROP: Soybean at ACRE; Corn at DPAC

SOIL AND PLANT SAMPLING

Table 2. Biomass and Tissue Sampling dates 2013.

	ACRE	DPAC
PLANTING	13-May	19-May
CORN		
V6 - 6 leaves	17-Jun	24-Jun
R1 - Silking	24-Jul	7-Aug
R6 - Maturity	4-Oct	11-Oct
Harvest	25-Oct	7-Nov
SOYBEAN		
V4 - 4 trifoliates	17-Jun	24-Jun
R4 - Flowering	22-Jul	7-Aug
R4 - Full Pod	2-Oct	7-Oct
Harvest	10-Oct	28-Oct

- Soil was collected during early plant sampling (V4/V6) and post-harvest at both sites for all treatments (0-30 and 30-60 cm).

STATISTICAL ANALYSIS: Analysis of variance was used to determine treatment effects via PROC GLM in SAS version 9.3 (SAS Inst., Cary, NC) followed by means separation according to Fischer's Protected $LSD_{0.05}$.