Soil Amendment Effects on Pesticide-Free Flaxseed Production in Central Iowa

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Introduction

Demand for flaxseed (*Linum usitatissimum*) oil has recently increased due to the discovered health benefits and a new market for organic flaxseed in NW Iowa. Limited research concerning adequate fertility and the effect of weed competition on yield exists for producers in the Midwest. Flax growers must factor not only seed yield but also seed oil concentration into their management strategies in order to meet industry standards. Endres et al. (2001) and Dybing et al. (1964) have associated decreases in seed oil concentration with higher nitrogen application rates. Therefore, understanding the effect of nitrogen fertility and weed competition on both seed yield and oil concentration is of significant importance to growers.

Materials and Methods

The experiment was conducted in 2007 and 2008 near Boone, IA. The study was arranged in a randomized complete block design with four replicates of each treatment and conducted following both soybean and corn. The main plots received one of three fertility sources (manure, compost, or urea) applied at one of the three target rates (34, 68, or 102 kg N ha^{-1}) or an unamended control (0 kg N ha^{-1}). Flax seed ('York') was drilled at a rate of 57 kg ha^{-1} accompanied by a red clover ('Arlington') underseeding broadcasted at a rate of 16 kg ha^{-1}. Each plot was divided into two subplots. One subplot was hand weeded while the other allowed for unabated weed growth to determine the effect of competition.

For each subplot flax was hand-harvested, air-dried, and threshed to determine seed yield in both years. Seed was analyzed to determine oil concentration in 2007 only.

Orthogonal polynomial contrasts were used to fit flaxseed yield response curves. Tests of significance were made at p = 0.05.

Figure 1. Flaxseed yield response to fertility following soybean and weeds removed in 2007. Values averaged across all fertility sources.

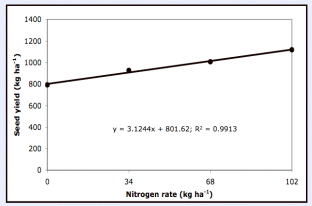


Figure 2. Flaxseed yield response to fertility following soybean and weeds unabated in 2007. Values averaged across all fertility sources.

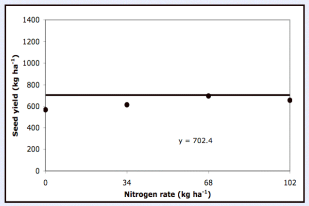


Figure 3. Flaxseed yield response to nitrogen fertility source following corn and weeds removed in 2007. Mean fit yield responses for each fertility source.

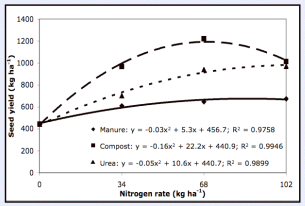
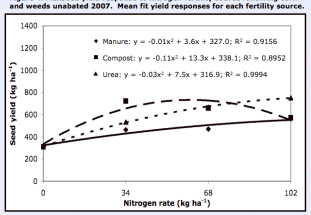


Figure 4. Flaxseed yield response to nitrogen fertility source following corn and weeds unabated 2007. Mean fit yield responses for each fertility source.



Results

Seed yield

The effect of fertility rate and source on flaxseed yield was dependent on the previous crop and the presence or absence of weed competition in 2007. When flax followed soybean, only the effect of fertility rate was significant when weed competition was removed (Fig. 1). When weeds were unabated, neither the effect of fertility rate nor source was significant (Fig. 2). When flax followed corn, both the effects of fertility rate and source were significant when weeds were removed (Fig. 3) and when weeds were unabated (Fig. 4). Weed competition reduced yields to 68 and 70% of flax grown free of competition when following soybean and corn, respectively. In 2008, flaxseed yield was not significantly affected by fertility rate or source. Weed competition reduced yields to 46% of flax grown free of competition when following soybean (Table 1). Weed competition did not significantly reduce yield when flax followed corn.

Oil concentration

Flaxseed oil concentration was not significantly affected by fertility rate or source in 2007. Weed competition significantly reduced the seed oil concentration when flax followed soybean but not when flax followed corn (Table 2).

Table 1. Flaxseed yield following soybeans or corn without or with weeds in 2008.

Previous crop	Seed yield
	kg ha^{-1}
Soybean	
weeds removed	401.5a
weeds unabated	185.9b
LSD	70.0
Corn	
weeds removed	184.3a
weeds unabated	168.7a
LSD	47.7
Mean	235.4

[1]By previous crop, means with the same letter are not significantly different. (p = 0.05).

Table 2. Flaxseed oil concentration following soybeans or corn without or with weeds in 2007.

Previous crop	Oil concentration
	g kg^{-1}
Soybean	
weeds removed	443.4a[1]
weeds unabated	440.0b
LSD	2.7
Corn	
weeds removed	449.2a
weeds unabated	446.5a
LSD	3.1
Mean	444.8

[1]By previous crop, means with the same letter are not significantly different. (p = 0.05).

Conclusion

Fertility significantly increased seed yields in 2007 except when flax followed soybeans and weed competition was present. The presence of weed competition not only reduced seed yields but also reduced the benefit of added nitrogen fertility in accordance with the findings of Bell and Nalewaja (1967). The lower seed yields and the lack of seed yield response in 2008 are most likely the result of excess moisture conditions experienced that year.

Seed oil concentration was not influenced by nitrogen fertility. It is important to note that this occurred in light of the increase of seed yield. The price a flaxseed grower receives is primarily determined by total seed mass produced. However, price premiums can be obtained for food-grade flaxseed that meets the oil concentration standard of 410.0 g kg^{-1} (Vakulabharanam, 2008). Based on the first year's data in this study, nitrogen fertility effectively increased flaxseed yield without adversely effecting seed oil concentration.

References

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Acknowledgments

The authors wish to thank Dr. Garritt Page and Dr. Philip Dixon for aiding with statistical analyses. Additionally, the services of Glen Rippke in the ISU Grain Quality Lab are greatly appreciated. Funding for this research was provided by the ISU Agronomy Endowment and the Leopold Center for Sustainable Agriculture.