Impact of the Invasive Shrub Autumn Olive on Soil Nitrogen and Cohabiting Plant Growth

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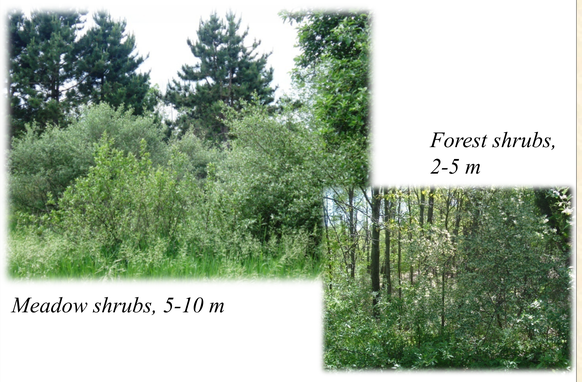
Introduction

Autumn olive (*Elaeagnus umbellata* Thunb.) is a non-native, invasive, nitrogen-fixing shrub that thrives in abandoned farm fields, roadsides, and some forest understories.

Autumn olive (AO) grows faster than native plants by accumulating higher leaf chlorophyll and driving faster net primary productivity than co-habiting plants in both high- and low-light environments in N-poor soils.



Forest shrubs, 2-5 m

Meadow shrubs, 5-10 m

Objectives

- Determine if AO altered chlorophyll content and growth rates of cohabiting plants in pots and field environments (previous work demonstrated that AO 'nursed' black walnut)
- Measure nitrogen (nitrate and ammonium) content in soils with and without AO during and post growing seasons
- Evaluate the potential of AO to affect survival of cohabiting plants using
  - Overwintering success in potting study
  - Germination bioassays

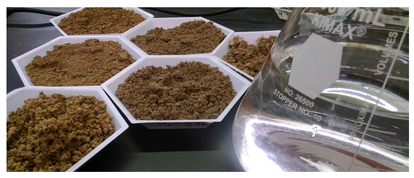
Methods

Potting Study:

Pairs of plant seedlings were transplanted into 4L pots, AO with one of four native plants or AO-AO and each native species with another member of the same species throughout the summer.

Field Cohort Study:

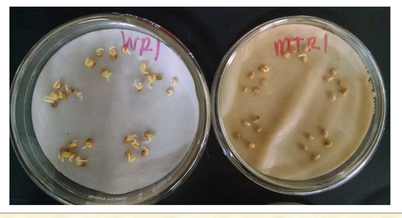
Soil Fertility. Composite soil samples (20 replicate pairs) were collected from under AO plants and 10 m distant from AO during June, July, and November, extracted with dH_2O/40 mM HNO_3; extracts were analyzed by ion chromatography.



Leaf Chlorophyll and Protein. Virginia creeper and Kentucky bluegrass leaves growing with AO or independent from AO were collected and assayed as replicate pairs for protein (Bradford's) and chlorophyll (SPAD) content.

Allelopathy by AO:

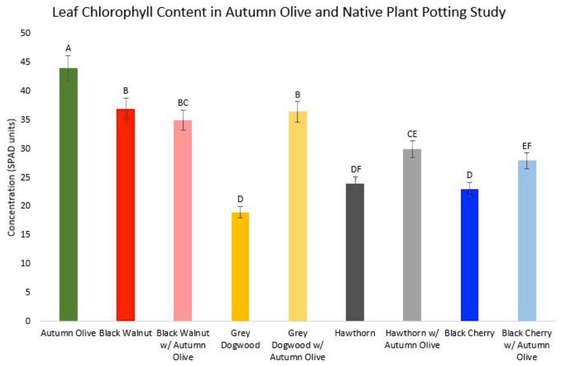
The impact of AO on other plants was determined by counting the number of plants in pots that survived one winter and by germinating four species of seeds in AO soil, root, green or frozen leaf aqueous extracts.



Results

AO increased cohabitant leaf chlorophyll and reduced total leaf protein content.

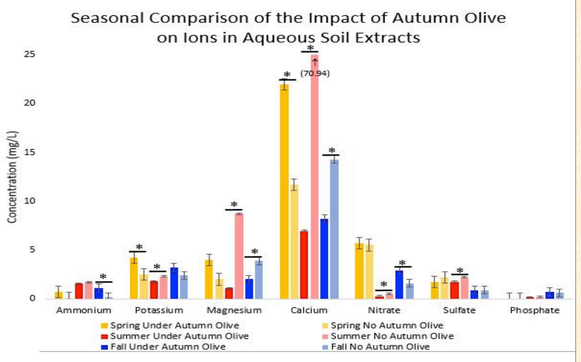
Potting Study:



Field Study:

	Under Autumn Olive	No Autumn Olive	P-value	Significant
Protein Content (mg/g dry wt)	1.45	1.56	0.0487	Yes
Chlorophyll Content (SPAD units)	22.5	18.5	0.0088	Yes

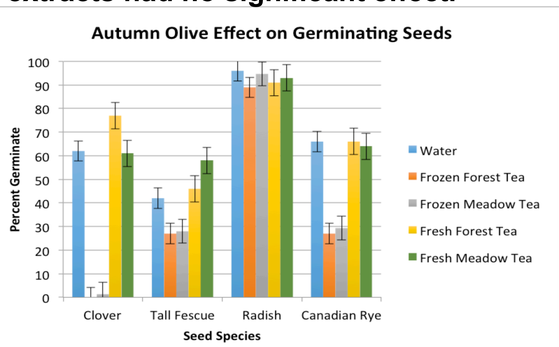
FEWER nutrients were available in AO soils during the growing season, MORE in late fall.



AO induced mortality of native cohabitants following winter.

Treatment	Native Mortality %	Autumn Olive Mortality %
Autumn Olive- Autumn Olive	0 A	0 A
Autumn Olive- Black Cherry	35 B	10 A
Autumn Olive- Black Walnut	45 B	0 A
Autumn Olive- Grey Dogwood	35 B	0 A
Autumn Olive- Hawthorn	25 A	0 A

Frozen AO leaf extracts reduced germination and produced abnormal seedlings in three of four species; whereas fresh leaf, root, or soil extracts had no significant effect.



Conclusions

- The rapid growth of AO and its high transpirational demand depleted soil nutrients during the growing season. Nitrate and ammonium accumulated in AO soils during late fall, however, presumably from nitrogen-fixing AO, potentially 'nursing' cohabitant plants and altering ecological function.
- AO stimulates the growth of native plants in its rhizosphere by increasing leaf chlorophyll and growth rates; but, later reduced winter survival.
- Previous research has reported both stimulation and inhibition of cohabiting plants by AO. Both could be true.
  - Altered soil fertility could enhance cohabitant growth (chlorophyll, NPP, more leaves) during the growing season.
  - Leaf drop of green leaves after freezing could release compounds inhibiting germination and seedling growth of competing plant species.

Acknowledgements

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