Biochar Effects on Wheat Productivity in Chemical Fallow

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Introduction

Soil organic matter (SOM) continues to decline under the traditional winter wheat summer fallow cropping system (WW-SF) that is predominant in the Pacific Northwest. The continuous depletion of SOM is beginning to threaten sustainability of WW-SF. The decline in SOM is mostly attributed to insufficient residues (one crop in two years) and tillage that accelerates SOM decomposition. Chemical fallow slows down SOM decomposition but does not make up for the insufficient residues. Given that the WW-SF is reliable and may be the only viable system in drier areas, ways to increase SOM in this system have to be devised. Biochar may provide the answer. Biochar is charcoal produced from pyrolysis (combustion at low oxygen levels) and is resistant to decomposition. Biochar increases soil water holding capacity, cation exchange capacity, nutrient retention capacity, fertilizer use efficiency, and soil microbial populations, all conditions required for sustained crop production

Methods

This study evaluated the effects of biochar derived from forest wastes on wheat grown under chemical fallow at rates of 0, 10, 20, and 40 tons/acre in 2012. The biochar contained 90% C, 0.18% N, C/N of 500, and a pH of 10.6. The biochar was applied in the summer of 2012 during the fallow phase. Winter wheat (Clearfield 102) was sown in the fall of 2012. Grain yield, ears/m^2, and test weight were determined at maturity in 2013. Soil pH of pot soil amended at the same biochar rates was determined after wheat harvest.

Preliminary Results

Increasing biochar from 0 to 40 tons/acre increased grain yield from 45 to 60 bu/acre (Fig. 1), an increase of 26 to 33%. However, applying biochar at rates above 10 tons/acre did not significantly increase yield. Biochar application did not influence ears/m^2 and test weight (Table 1). Applying biochar increased soil pH by a factor of 0.21 (Fig. 1).

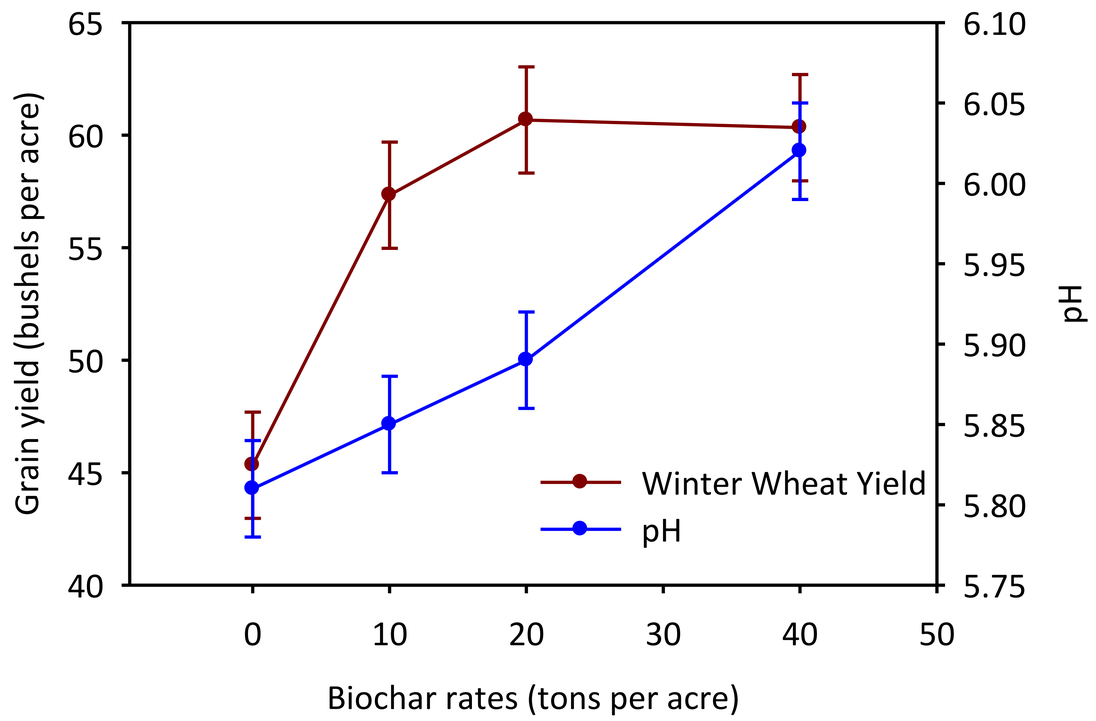
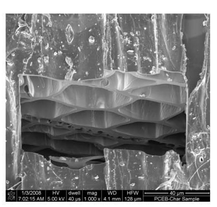
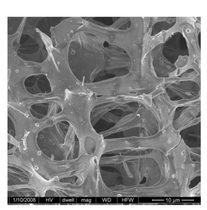


Fig. 1. Biochar Effects on Wheat Grain Yield and Soil pH in Anthena, OR during the 2012-13 Crop-year. Bars represent standard error.

Table 1. Biochar effects on wheat grain yield, ears/m^2, and test weight under chemical fallow, Athena, OR, 2012-13 crop-year.

Treatment	†Wheat Yield (bu/a)	Yield Increase (%)	Ears/m^2	†Test weight (lb/bu)
0	45.33 b	0	634 a	58 a
10	57.33 a	26	505 a	56 a
20	60.67 a	34	576 a	58 a
40	60.33 a	33	457 a	59 a
s.e.	2.36	-	70	1.10

†Treatment means with the same letter are not significantly different from each other at the 0.05 probability level (Tukey Test)

Conclusions

Preliminary results indicated that biochar has the potential to increase grain yield of winter wheat grown under summer fallow. The biochar used was alkaline and may have a potential to reduce the acidity that is increasingly evident in fields fertilized with N compounds and in chemical fallow systems. This study continues.