BIDANG ILMU : PERTANIAN

LAPORAN HASIL
PENELITIAN DISERTASI DOKTOR
TAHUN ANGGARAN 2010

Judul : **PRODUKSI DAN APLIKASI BIOCHAR / ARANG DALAM MEMPENGARUHI TANAH DAN TANAMAN**

Peneliti **: WIDOWATI**

Dibiayai Oleh Direktorat Jenderal Pendidikan Tinggi, Kementerian Pendidikan Nasional sesuai dengan Surat Perjanjian Penugasan Dalam Rangka Pelaksanaan Penugasan Penelitian Disertasi Doktor Tahun Anggaran 2010
Nomor : 492/SP2H/PP/DP2M/VI/2010, tanggal 11 Juni 2010.

Universitas Brawijaya
Malang
2010

LEMBAR PENGESAHAN
PENELITIAN DISERTASI DOKTOR
TAHUN ANGGARAN 2010

1. Judul Penelitian Hibah	:	Produksi dan Aplikasi Biochar/ Arang dalam Mempengaruhi Tanah dan Tanaman
2. Bidang Ilmu (penelitian)	:	Pertanian
3. Judul Disertasi	:	Potensi Biochar dalam Efisiensi Pemupukan Nitrogen untuk Mewujudkan Produktivitas yang Berkelanjutan
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12. Biaya Penelitian	:	Rp. 33.950.000
13. Lokasi Penelitian	:	

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RINGKASAN

Percobaan I
Biochar dan Pupuk Organik dengan dan Tanpa NPKpada Pertumbuhan Tanaman Jagung

Aplikasi biochar dan pupuk organik yang ditambah NPK dan tanpa NPK pada tanaman jagung telah dilakukan di rumah kaca, bertujuan untuk mempelajari efisiensi pemupukan N dan pengaruhnya terhadap sifat kimia, biologi, dan fisika tanah. Hasil penelitian menunjukkan efisiensi pemupukan N dengan biochar pupuk kandang (86,80%) tidak berbeda dengan biochar sampah organik kota (84,17%). Efisiensi pemupukan N dari pupuk kandang (72,61%) dan kompos (33,75%), serta kombinasi pupuk kandang dengan biochar pupuk kandang (34,3%), dengan biochar sampah (29,39%). Biochar-NPK meningkatkan total panjang akar. Tanpa NPK, biochar pupuk kandang (9,64 mg/kg) mempunyai kemampuan yang lebih baik dalam menghasilkan amonium daripada pupuk kandang (7,83 mg/kg) pada umur 8 minggu. Biochar sampah (17,86 mg/kg) menyebabkan kadar nitrat yang lebih tinggi daripada kompos (7,44 mg/kg). Sementara itu dengan NPK, kadar nitrat dari aplikasi biochar sampah (70,97 mg/kg) lebih tinggi daripada kompos (46,98 mg/kg) sedangkan kadar ammonium dari biochar sampah (25,23 mg/kg) lebih tinggi daripada kompos (18,13 mg/kg). Biochar pupuk kandang-NPK maupun tanpa NPK berpengaruh baik terhadap ketersediaan NPK tanah. Penurunan bahan organik tanah yang dipupuk NPK pada kedalaman 0-10 cm dan 10-20 cm akibat kombinasi biochar dan pupuk organik < biochar < pupuk organik. Penurunan bahan organik tanah dengan kompos > pupuk kandang. Biochar-NPK menghasilkan biomassa mikrobia yang lebih tinggi daripada pupuk organik-NPK. Biochar maupun pupuk kandang member pengaruh yang sama terhadap bobot isi tanah. Porositas tanah dari biochar (46-48%) > kombinasinya dengan pupuk kandang (36-37%). Porositas tanah daripupuk kandang (53%) > kompos (37%). Kemantapan agregat tanah dari pupukkandang = kompos = biochar sampah tetapi < biochar pupuk kandang.

Percobaan II
Efek Residu Biochar, Pupuk Organik Lama dan Baru pada Tanah dan Tanaman

Penelitian ini merupakan lanjutan yang dilakukan di rumah kaca. Bertujuan untuk mempelajari efek residu biochar dan pupuk organik lama dan baru pada pertumbuhan tanaman jagung serta pengaruhnya pada sifat kimia dan fisika tanah. Hasil penelitian menunjukkan produksi biomassa dari biochar berbeda dengan pupuk organik baru. Residu biochar berpengaruh baik terhadap peningkatan total panjang akar dan bobot kering akar pada tanaman berikutnya. Serapan NPK dari biochar menurun dibanding pupuk organik baru. Kombinasi pupuk kandang dan biochar pupuk kandang tidak menaikkan jumlah ammonium dan nitrat dibandingkan biochar saja. Biochar pupuk kandang menunjukkan jumlah ammonium dan nitrat yang lebih tinggi daripada pupuk organik lama dan baru. Banyaknya ammonium dan nitrat pada umur 8 minggu berturut-turut sebesar 520,75 mg/kg dan 831,26 mg/kg (biochar pupuk kandang) serta 226,57 mg/kg dan 555,34 mg/kg (biochar sampah). Bahan organik tanah akibat pupuk organik baru meningkat 13,76% (kedalam 0-10 cm) dan 19,79% (kedalaman 10-20 cm). Pada berbagai kedalaman tanah, bahan organik tanah dari residu biochar = pupuk organik baru. Kadar N tanah dari biochar = pupuk organik lama. Biochar menghasilkan KB dan kadar K tanah yang lebih tinggi daripada

pupuk organik. pH tanah lebih baik dengan biochar daripada pupuk kandang. KTK tanah dari pupuk kandang lama = kompos lama = kompos baru = biochar yaitu berkisar 36- 38 me/100 g. Pupuk kandang lama dan baru dapat meningkatkan KTK menjadi40,72 me/100 g. Kombinasi pupuk kandang lama dan biochar menghasilkan KTKtanah sebesar 38 me/100 g. Bobot isi, porositas, dan kemantapan agregat tanah dari biochar = pupuk organik lama = pupuk organik baru.

Percobaan III
Pencucian Nitrat (N-NO3-) dan Amonium (N-NH4+)dengan Biochar dan Pupuk Organik

Penelitian bertujuan untuk mempelajari pengaruh biochar dan pupuk organic terhadap pencucian nitrat dan ammonium. Pencucian di laboratorium dengan menggunakan tabung pencucian. Biochar 50 ton/ha dan pupuk kandang maupun kompos 30 ton/ha ditambah pupuk urea 300 kg/ha. Banyaknya nitrat dan amonium yang tercuci diamati pada 1, 2, 4, 8 minggu. Hasil penelitian menunjukkan bahwa banyaknya nitrat yang tercuci lebih besar daripada ammonium. Selama 2 minggu, akumulasi penurunan pencucian nitrat dengan pupuk organik dan biochar masing-masing sebesar 46,48% dan 48,20% disbanding kontrol. Biochar pupuk kandang dapat menekan kehilangan nitrat sebesar 182,64% dibanding biochar sampah. Selama 4 minggu, akumulasi penurunan pencucian nitrat dari pupuk kandang, kompos, biochar pupuk kandang, dan biochar sampah organik berturutan sebesar 70,46%; 23,81%; 69,71%; dan 18,49% dibanding kontrol. Pencucian nitrat menunjukkan perbedaan yang sangat nyata diantara pupuk organik maupun diantara biochar. Selama 8 minggu, akumulasi pencucian ammonium dari pupuk organik sama dengan biochar. Pupuk kandang dapat menurunkan pencucian nitrat sebesar 51,86% sedangkan kompos meningkatkan pencucian nitrat sebesar 7,42%. Banyaknya ammonium yang tercuci dari aplikasi biochar 8 minggu lebih besar dari kontrol sebesar 23,64% (biochar pupuk kandang), 44,08% (biochar sampah), 12,5% (pupuk kandang) dan 46,98% (kompos).

SUMMARY

Experiment I
Biochar With and Without Organic Fertilizer NPK Corn on Plant Growth

Biochar application and NPK plus organic fertilizer and without NPK on maize crops have been conducted in the greenhouse, aims to study the efficiency of N and its influence on the nature of chemical, biological, and soil physics. The results showed the efficiency of N fertilization with manure biochar (86.80%) was similar to urban organic waste biochar (84.17%). The efficiency of N from manure (72.61%) and compost (33.75%), and their combination with biochar manure (34.3%), with biochar waste (29.39%). Biochar-NPK increased the total root length. Without NPK, biochar manure (9.64 mg / kg) had a greater ability to produce ammonium than manure (7.83 mg / kg) at the age of 8 weeks. Biochar garbage (17.86 mg / kg) caused a higher nitrate content than the compost (7.44 mg / kg). Meanwhile, with NPK, levels of nitrates from waste biochar application (70.97 mg / kg) higher than compost (46.98 mg / kg) while the levels of ammonium from the waste biochar (25.23 mg / kg) higher than compost (18.13mg / kg). Biochar manure-NPK and without it effected good on the availability of NPK soil. The decline of soil organic matter fertilized NPK at a depth of 0-10 cm and 10-20 cm due to a combination of biochar and organic fertilizers < biochar <organic fertilizer. Decline in soil organic matter with compost > manure. Biochar-NPK yield a higher microbial biomass than organic fertilizer-NPK. Biochar and farmyard manure gave the same effect on the weight content of the soil. Porosity of the soil from biochar (46-48%) > combination with manure (36-37%). Porosity of the soil from manure (53%) > compost (37%). Soil aggregate stability ofcompost manure = biochar rubbish but < biochar manure.

Experiment II
Residual Effects Biochar, Old and New Organic Fertilizer on Soil and Plant

This study represents a continuation conducted in the greenhouse. Aiming to study the residual effects of biochar and old and new organic fertilizer on corn plant growth and its effects on soil chemical and physical properties. The results showed different biomass production of biochar with new organic fertilizer. Biochar residue affects both the increase in total root length and root dry weight in the next crop. NPK uptake of biochar decline compared with the new organic fertilizer. The combination of manure and manure biochar does not increase the amount of ammonium and nitrate than biochar alone. Biochar manure showed the amount of ammonium and nitrate is higher than the old and new organic fertilizer. The number of ammonium and nitrate at the age of 8 weeks in a row at 520.75 mg / kg and 831.26 mg / kg (biochar manure) and 226.57 mg / kg and 555.34 mg / kg (biochar garbage). Soil organic matter due to the new organic fertilizer increased by 13.76% (depth 0-10 cm) and 19.79% (a depth of 10-20 cm). At different depths in soil, soil organic matter from the residue biochar = new organic fertilizer. Soil N concentration of organic fertilizer biochar = long. Biochar produces KB and K soil levels higher than organic fertilizers. pH soil with biochar is better than manure. Soil CEC from manure compost old = old = new = biochar composts it ranged 36-38 me/100 g. Old and new manure can increase the CEC to be 40.72 me/100 g. The combination of old manure and produce biochar soil CEC by 38 me/100 g. Weight content, porosity, and soil aggregate stability of organic fertilizer biochar = old = new organic fertilizer.

Experiment III
Nitrate Leaching (N-NO3-) and Ammonium (N-NH4+) with Biochar and Organic Fertilizer

The research aims to study the effect of biochar and organic fertilizers on the leaching of nitrate and ammonium. Laundering in the laboratory using washing tube. Biochar 50 tons / ha and manure or compost 30 tons / ha plus 300 kg urea /ha. Number of leached nitrate and ammonium were observed at 1, 2, 4, 8 weeks. The results showed that the amount of nitrate leached is greater than ammonium. Over the past 2 weeks, the cumulative reduction of nitrate leaching with organicfertilizer and biochar respectively 46.48% and 48.20% compared to controls.Biochar manure can suppress the loss of nitrate by 182.64% compared to biochargarbage. Over the past 4 weeks, the cumulative reduction in nitrate leaching frommanure, compost, manure biochar, and biochar successive organic waste by70.46%, 23.81%, 69.71% and 18.49% compared to controls. Nitrate leaching showed a highly significant difference between organic fertilizers as well as between biochar. During the 8 weeks, accumulated ammonium leaching of organic fertilizer with biochar. Manure can reduce nitrate leaching by 51.86% while the compost increase of 7.42% nitrate leaching. The number of ammonium leached from biochar application 8 weeks is greater than the control by 23.64% (biochar manure), 44.08% (biochar garbage), 12.5% (manure) and 46.98% (compost).

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