United States Department of Agriculture
Agricultural Marketing Service | National Organic Program
Document Cover Sheet
https://www.ams.usda.gov/rules-regulations/organic/national-list/petitioned

Document Type:

☒ **National List Petition or Petition Update**

A petition is a request to amend the USDA National Organic Program's National List of Allowed and Prohibited Substances (National List).

Any person may submit a petition to have a substance evaluated by the National Organic Standards Board (7 CFR 205.607(a)).

Guidelines for submitting a petition are available in the NOP Handbook as NOP 3011, National List Petition Guidelines.

Petitions are posted for the public on the NOP website for Petitioned Substances.

☐ **Technical Report**

A technical report is developed in response to a petition to amend the National List. Reports are also developed to assist in the review of substances that are already on the National List.

Technical reports are completed by third-party contractors and are available to the public on the NOP website for Petitioned Substances.

Contractor names and dates completed are available in the report.

Petitioner Cover

Thank you for the opportunity to submit a petition regarding the NOSB sunset substance topic of "Ash from Manure Burning." We recognize and appreciate that NOSB guidelines need to prevent misclassifications of organic soil amendments that do not improve the soil's physical characteristics. However, we also recognize that there is a substantial body of scientific research and data that supports the contention that "not all manure ash is created equal," and that the ash inherent in dairy manure-derived biochar serves to improve the most important physical properties of soils. The petitioner will present scientific research papers to support this contention.

The wholesale elimination of ash from all forms of pyrolysis, incineration, combustion, gasification, etc. of manure as an organic soil amendment is also a wholesale elimination of all manure-derived nutrient biochar as an organic soil conditioner. The reference documents clearly show that a manure-derived biochar, produced in well controlled pyrolysis conditions, increases nutrient availability, water retention, microbial activity, soil organic matter, and crop yields in soils while decreasing greenhouse gas emissions, fertilizer needs, nutrient leaching, and erosion. The higher the temperature of manure biochar production, the higher the ash content; however, higher temperatures also improve pore structure, volume, and surface area, contributing to an improved adsorption performance of the biochar. Increased ash content of the biochar has been shown to correlate with improvement in heavy metal and other pollutant adsorption capabilities of the biochar.

Manure-derived biochar inherently contains higher ash content, higher water-soluble salts, and a higher cationic exchange capacity than plant-derived biochar, which makes manure-derived biochar a very effective adsorbent for soil remediation. There are other attributes of manure-derived biochar that contribute to its potential as a valuable organic soil amendment; however, we are primarily addressing the topic of the ash inherent in manure-derived biochar and the demonstrated performance improvement characteristics of the ash when inherent in the biochar structure as it relates to the NOSB sunset substance topic of "Ash from Manure Burning."

The petitioner recommends that the NOSB reconsider the issue of the ash inherent in manure-derived biochar produced under controlled pyrolysis conditions. The reference papers should help substantiate the fact that this product is a valuable soil amendment that should qualify for organic classification because manure derived biochar truly improves the physical characteristics of soils.

In November of 2018, Akio Enders, Joshua Stone, Leilah Krounbi, and Johannes Lehmann of the Department of Soil and Crop Sciences, Cornell University, with John Gaunt of the Department of Soil and Crop Sciences, Cornell University and GreenTree Garden Supply of Ithaca, NY joined with Rajesh Chintala of the Innovation Center for U.S. Dairy, to publish a paper entitled *"Feasibility Assessment of Dairy Biochar as a Value-Added Potting Mix in Horticulture and Ornamental Gardening"*. The Innovation Center for U.S. Dairy funded this research, and based on the findings, Newtrient LLC, Rosemont, IN on behalf of the dairy industry is petitioning NOSB to add an annotation (i.e., a clarifying statement) to the substance currently prohibited on § 205.602(a) "Ash from manure burning" indicating that ash from manure burning does not include biochar derived from pyrolysis of cow manure.

The following formal petition for annotating § 205.602(a) to exclude Cow Manure Derived Biochar is based on NOP 3011 National List Petition Guidelines:

Cow Manure Derived Biochar Petition

The purpose of this petition is to request an annotation (i.e., a clarifying statement) to the substance currently prohibited on § 205.602(a) "Ash from manure burning" indicating that ash from manure burning does not include biochar derived from pyrolysis of cow manure. This petition advocates dairy manure-based biochar as an excellent tool to avoid the negative effects of nutrient leaching and other issues dealing with large volumes of raw manure while highlighting other advantages of manure-based biochar over plant-based biochar.

Suggested addition of annotation to § 205.602(a) "Ash from manure burning":

> § 205.602 Nonsynthetic substances prohibited for use in organic crop production.
> The following nonsynthetic substances may not be used in organic crop production:
>
> (a) Ash from manure burning – unless derived as part of the production of biochar from pyrolysis of cow manure.
>
> (b) Arsenic.
>
> (c) Calcium chloride, brine process is natural and prohibited for use except as a foliar spray to treat a physiological disorder associated with calcium uptake.
>
> (d) Lead salts.
>
> (e) Potassium chloride - unless derived from a mined source and applied in a manner that minimizes chloride accumulation in the soil.
>
> (f) Rotenone (CAS # 83-79-4).
>
> (g) Sodium fluoaluminate (mined).
>
> (h) Sodium nitrate - unless use is restricted to no more than 20% of the crop's total nitrogen requirement; use in spirulina production is unrestricted until October 21, 2005.
>
> (i) Strychnine.
>
> (j) Tobacco dust (nicotine sulfate).
>
> [68 FR 61992, Oct. 31, 2003, as amended at insert proper reference]

OFPA Category - Crop and Livestock Materials: Cow Manure Derived Biochar as a fertilizer and soil amendment/soil conditioner is a production aid for organic crop production.

Information on Cow Manure Derived Biochar:

1. Substance Name: The substance's common names are Cow Manure Biochar, Dairy Biochar, Dairy Manure Biochar, Cow Manure Derived Biochar, Dairy Manure Sourced

Biochar, Manure Derived Char or Dairy Manure Char; hereinafter referred to as Cow Manure Derived Biochar (**CMDB).**

2. Petitioner Information
   Mark Stoermann
   10255 W. Higgins Road, Suite 900
   Rosemont, IL 60018
   (219) 712-3511

3. Intended Use
   The intended use of CMDB is as a Carbon Storage Soil Amendment/Soil Conditioner and a Fertilizer for Organic Crop Production

4. Intended Activities and Application Rate
   a. A Carbon Storage Soil Amendment/Soil Conditioner – CMDB is 178% more dense than the manure at 503 lbs./yd^3, with ash content increased to 38%. The International Biochar Initiative (IBI) classification tool calculates the Carbon Storage Class of this biochar as 1, on a scale of 1-5 with 5 providing the highest carbon storage potential. This rating integrates both carbon quality and quantity. The high ash content of this biochar downplays the quality of the carbon present, hence the low rating. However, the quality of the carbon is such (i.e., low H/C_{org} ratio) that roughly half is expected to persist over 100 years, compared to practically none in the manure. Application rates may vary.
   b. Fertilizer for Organic Crop Production - The Fertilizer Class of CMDB, according to the IBI classification system, is 3 on a scale of 0-4. This is defined as providing adequate nutrition for corn at < 4.5 tons/acre providing three out of four nutrients. Specifically, the calculation states that phosphorous, potassium, and magnesium requirements are met by application of 4.0, 1.3, and 1.3 tons/acre.

5. Manufacturing Process
   CMDB, when heated under oxygen-free conditions, in a process known as pyrolysis, is converted into a charcoal like substance called biochar. During this process, carbon chains fuse into rings (McBeath et al., 2014). These substances resist decomposition in the soil and can even slow the decomposition of non-biochar carbon (DeCiucies et al., 2018). As pyrolysis temperature increases, biochar surface area increases along with pH (Mukherjee et al., 2011). Pyrolysis concentrates plant nutrients when compared to the biomass feedstock (Enders et al., 2012).

6. Ancillary Substances
   CMDB contains no ancillary substances.

7. Previous Reviews
   "Feasibility Assessment of Dairy Biochar as a Value-Added Potting Mix in Horticulture and Ornamental Gardening;" Akio Enders, Joshua Stone, Leilah Krounbi, Johannes Lehmann, John Gaunt, Rajesh Chintala; November 2018.

8. Regulatory Authority

There are no current EPA, FDA, and State regulatory authority registrations or registration numbers.

9. Chemical Abstracts Service (CAS) Number and Product Labels
This product does not have a CAS number or other product numbers.

10. Physical and Chemical Properties
Physical properties and chemical mode of action of Cow Manure Derived Biochar include the following:
    a. Chemical interactions with other substances, especially substances used in organic production:
        (a) Application of CMDB was significantly more effective than that of Cow Manure (CM), as it reduced the availability of Cadmium in soil by 34.3%-69.9% and its bioaccumulation in the low Cd accumulator, Aijiaoheiye 333, by 51.2% and 67.4% respectively. The addition of CMDB significantly increased the extractability and accumulation of trace metals (Zn, Mn, Fe, and Cu) by plants and improved plant biomass production. (Yasmin Khan Kiran, 2017)
        (b) "The application of biochar as a soil amendment can be used in alleviating the threat of pollution from manure borne progesterone." (Sanaz Alizadeh, 2016)
        (c) "The cumulative methane and yield in the AD (anaerobic digestion) with 10 g/L biochar were increased to 27.65% and 26.47% in psychrophilic, 32.21% and 24.90% in mesophilic and 35.71% and 24.69% in thermophilic digestions. The addition of M-BC (dairy manure-derived biochar) shortened the lag phase of AD at all temperatures in the study while it lowered the concentration of total VFAs and propionic acid. It was suggested that the high nutrients and alkalinity potential of M-BC would play significant roles in enhancing methane production and shortening lag phases from the AD of dairy manure." (Hyun Min Jang, 2018)

(d) Biochar co-amendments can be used as sorbents for contaminants from biosolid application in the environment or in agriculture. Biochar minimizes the contaminant mobility from biosolids. (Daniel A Bair, 2016)

(e) The CECs of (bio)chars are quite variable, ranging from mmol/kg to cmol/kg and depending on temperature, pH, and the original biomass. The incorporation of carboxylic oxygen groups and other surface functionalities with negative charge improve CEC (innate within biochar). By increasing CEC in the soil, fertility can be improved by reducing nutrient leaching. (Meriem Belhachemi, 2019)

b. Toxicity and environmental persistence:

(a) The IBI toxicant assessment is understandably quite stringent, screening for persistent organic pollutants: polyaromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), dioxins (PCDD) and furans (PCDF); toxic heavy metals including arsenic, cadmium, chromium, lead, mercury; trace elements that become toxic at higher quantities including: copper, molybdenum, nickel, selenium, and zinc; and phytotoxic elements including: boron, chlorine, and sodium. CMDB is non-toxic on all counts and contains 30 times less than the threshold value for any single analyte. Germination trials also assessed biochar toxicity. Of the three species used (lettuce, ryegrass, and radish) germination in dairy manure biochar amended media was nearly identical to the control.

(b) "Electronic conductivity and adsorption properties of biochar with changed microbial community contributed to the enhanced heavy metal stabilization and reduced nitrogen loss during bioleaching." (Xiaochen Wei, 2018)

(c) "Strong aromatic and hydrophobic and high molecular weight substances in biochar-derived DOM (dissolved organic matter) usually make DOM remain stable, with high resistance. The increase of those substances during the cultivation process also helped to enhance the stability of biochar-derived DOM." (Mei Huang, 2019)

(d) Large quantities of biochar organic matter were more inclined to be present in the form of humic acid-like (HAL) materials. Large-scale use of biochar in soil remediation and subsequent weathering would make a great contribution to humic acid content in the soil. Animal Manure-Based Biochar (AMIB) exhibited significantly higher Phenanthrene (PHE) $\log K_{OC}$ values than the Plant Straw-Based Biochar (PLAB). The surface organic carbon content of ANIBs was higher than the corresponding bulk organic carbon content, indicating that the organic matter is likely concentrated on the surface of ANIB particles. This configuration would enhance the accessibility of ANIB sorption domains for PHE molecules, which could be responsible for to the higher PHE sorption of ANIBs. (Jie Jin, 2018)

(e) The bioavailable heavy metal fractions (acid soluble/exchangeable fraction and reducible fraction) were transformed into the relatively stable fraction (oxidizable fraction) and very stable fraction (residual fraction) during pyrolysis. Bioavailability and toxicity of heavy metals in biochar were greatly reduced after pyrolysis. (Xinyi Zeng, 2018)

(f) Results showed that across all studies, biochar addition to soils resulted in average decrease of 38, 39, 25 and 17%, respectively, in the accumulation of Cd, Pb, Cu and Zn in plant tissues. The largest decrease in plant heavy metal concentrations occurred in coarse-textured soils amended with biochar. Manure-derived biochar was the most effective for reducing Cd and Pb concentrations in plants as compared to biochar derived from other feedstocks. Biochar having a high pH and used at high application rates resulted in greater decrease in plant heavy metal uptake. (de Chen, 2018)

c. Environmental impacts from the use and/or manufacture:
   (a) Biochar results in net savings of CO_2 emissions and thus can be considered as a measure to fight global warming. The expected savings in CO_2 emissions can be explained by the substituted amount of heat and electricity production and reduced fertilizer production, amongst other factors, but the highest share in total CO_2 savings is attributable to the application of biochar in soils. (Sara Rajabi Hamedani, 2019)
   (b) Biochar's climate-change mitigation potential stems primarily from its slower decomposition than the raw biomass from which it is generated, thus lowering the rate at which photosynthetically-fixed C is returned to the atmosphere (Wang et al. 2016) It is this *difference* in decomposition rates that is critical in determining how net carbon stocks evolve over time (Whitman et al. 2010).
   (c) Approximately half of the carbon in a biomass feedstock is emitted as CO_2 during biochar production; by comparison, more readily decomposed un-pyrolyzed biomass will rapidly return most of its carbon to the atmosphere if allowed to decompose. Therefore, the carbon stocks remaining over time are larger for biochar than for raw biomass, leading to a net increase in soil carbon stocks. Thus, although embedding carbon in biochar is, in one sense, a redistribution of biomass carbon rather than newly fixed carbon, nonetheless the greater persistence of the biochar drives a net sequestration of carbon. Most studies have concluded that this persistence-derived carbon sequestration is the largest influence of biochar on net greenhouse gas balances (Fowles 2007; Gaunt & Lehmann 2008; Roberts et al. 2010; Whitman et al. 2010; Woolf et al. 2010; Cowie et al. 2015).

d. Effects on human health:
   (a) The total and bioavailable Polycyclic Aromatic Hydrocarbon (PAH) concentration in biochar varied from 638 to 12,347 μg/kg and from below the detection limit (BDL) to 2792 μg/kg, respectively. The total PAH concentration in eight vegetables grown in biochar-amended soil varied according to biochar and vegetables type from BDL to 565 μg/kg. PAHs are produced during biochar production, and their concentrations and benzo [α]pyrene toxic equivalency quotient values decrease as the pyrolysis temperature increases. (Jian Wang K. X., 2018)
   (b) The PAH concentration from cow manure biochar produced through slow pyrolysis at 400 °C and extracted Soxhlet extraction with dichloromethane for 12 hrs. was negligible. Cattle manure slurries can contain PAH concentrations of 87-309 μg/kg, pig slurries 66-339 μg/kg, sewage sludge 1.7-126 μg/kg, and compost 0.8-2.7 μg/kg. Dairy manure biochar contains lower total PAH concentrations than these materials. (Sarah E. Hale, 2012)
   (c) The overall cancer risks through exposure to biochar-borne PAHs in soils and food crops were low. (Jian Wang E. S., 2019)
   (d) Biochar produced from lignocellulosic biomass under the same pyrolysis conditions did not show mutagenic activity in either tester strains TA98 and

TA100, with or without metabolic activation. Biochar from poultry litter, and manure from grass-fed calves had low mutagenicities. Biochar from pig manure had high mutagenicity; biochar from manure of cows fed on grass plus cereals, those of calves fed on mother's milk, and biochar from solid industrial waste had intermediate mutagenicities. (Anna V. Piterina, 2017)

e. Effects on soil organisms, crops, or livestock:
    (a) Enhanced soil fertility, changes in soil-water status, and specific stimulation compound within biochar can improve plant growth and crop yield. (S. Gao, 2016)
    (b) The longevity of the increases in crop yield and soil C after one-time application of biochar indicate that this practice provides great opportunities for intensifying agricultural production and mitigating greenhouse gas emissions. (Thomas Kätterer, 2019)

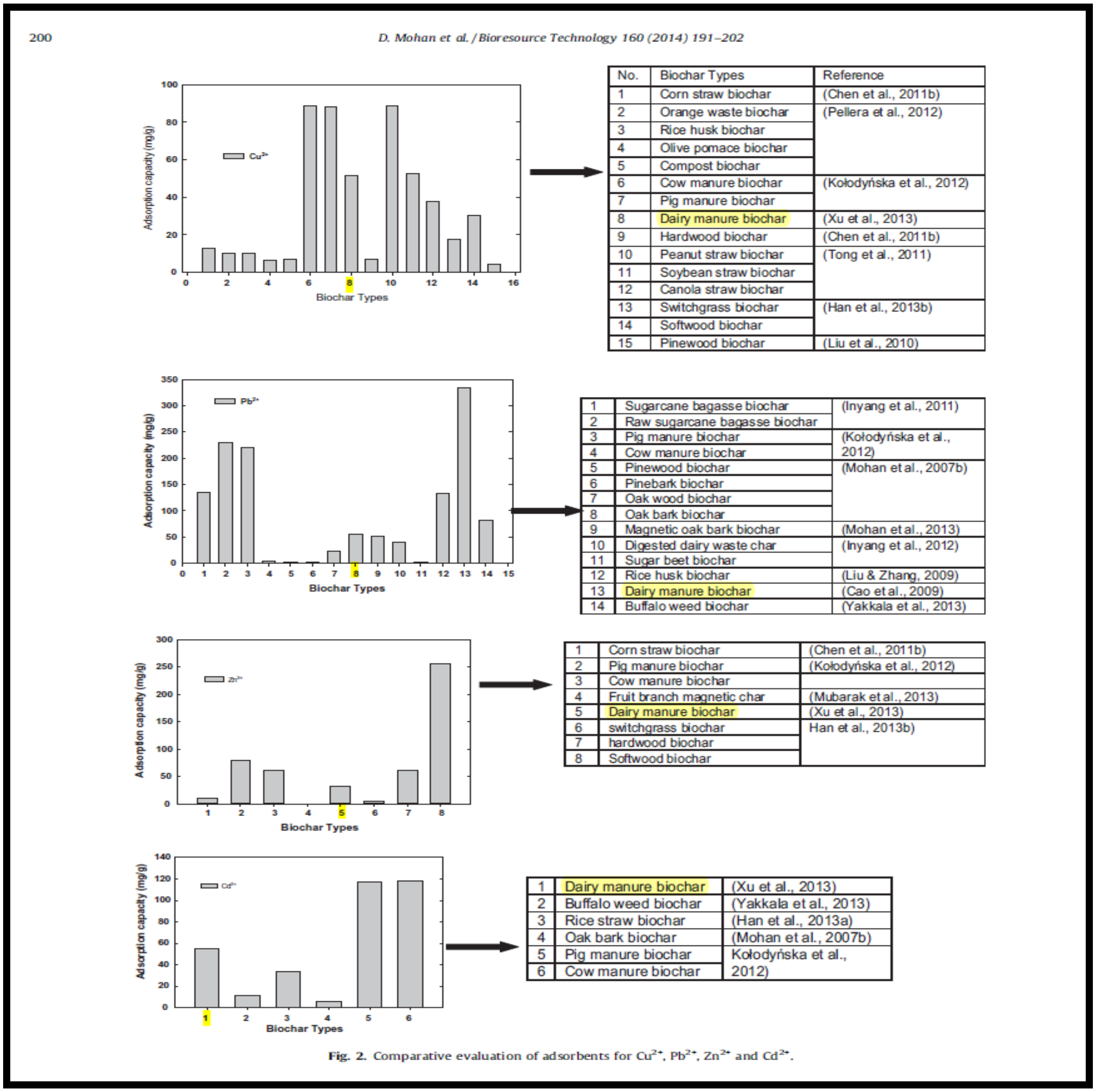
11. Safety Information about Cow Manure Derived Biochar:
    Safety information about the substance including a Material Safety Data Sheet (MSDS) and a substance report from the National Institute of Environmental Health Studies is not applicable.

12. Research Information:
    - "FTIR spectroscopic analysis showed the content of alcohols, phenols, ethers and esters decreased with the increases of creation temperature, that is, the process of forming biochar." (Qianli Ma, 2018)
    - The differences between digested manure biomass and biochar created from digested manure biomass indicate activated charcoal like biochar formed at higher reaction temperatures (Qianli Ma, 2018)
    - "SEM micrographs showed more porous and channel structures were observed in the biochar samples produced at higher temperature and inert atmosphere." (Qianli Ma, 2018)
    - "Analysis of the CO_2 adsorption isotherm by the DR equation identifies a SA (Surface Area) of 102 ± 2 m^2 g^{-1} and V_{mi} (CO_2, Micropore Volume) of 0.041 ± 0.001 cm^3 g^{-1}. These properties show good potential in adsorption and holding substances…" (Qianli Ma, 2018)
    - Digested dairy manure biochar has "tunable physicochemical properties" that "can be used for soil amendment to enhance soil aggregation, water holding capacity, and organic carbon content." (Qianli Ma, 2018)
    - Pyrolysis temperature was the dominant factor affecting biochar physiochemical properties. Regardless of the original feedstock, high-temperature pyrolysis (≥ 600 °C) produced biochar with a high pH, stability, recalcitranced, and HHV (Higher Heating Value). Biochar produced from low-temperature pyrolysis (≤ 400 °C) had a larger mass yield, higher energy recovery, more volatile content, and more diverse surface functional groups. (Simeng Li, 2018)
    - Several studies show that biochar displays notable affinity to heavy metals, used for the water purification, and for the immobilization of those contaminates in soils and sediments. "The reduction of mobility of heavy metals after application [of biochar] can take place through physical sorption by biochar, formation of complexes on biochar surface, precipitation on biochar surface, exchange with ions present in biochar structure, electrostatic interactions with the charge on biochar surface, and as

a result of increasing the pH" of substrate due to the introduction of biochar. (Paulina Godlewska, 2017)

13. Petition Justification Statement:
    - Cow Manure Derived Biochar, when produced under controlled pyrolysis conditions, should be allowed for use in organic crop production and an annotation (i.e., a clarifying statement) should be added to the substance currently prohibited on § 205.602(a) "Ash from manure burning" indicating unless derived as part of the production of biochar from pyrolysis of cow manure.. The justification for this annotation is based on the following characteristics of Cow Manure Derived Biochar that are not true of ash from manure burning:
        - Biochar generally increases (1) nutrient availability (2) microbial activity (3) soil organic matter (4) water retention and (4) crop yields in soils, while decreasing its (1) fertilizer needs (2) greenhouse gas emissions (3) nutrient leaching and (4) erosion (Dinesh Mohan a, 2014)
        - The Biochar adsorption process is controlled by a variety of factors, such as production temperature, presence of oxygen containing functional groups (carboxyl, hydroxyl), specific surface area, porosity, pollutant adsorbed, solution concentration, pH, and ambient temperature (Peizhen Zhang, 2019)
        - In general, the higher the pyrolysis temperature, the higher the ash content, but the high temperatures are needed because "as pyrolysis carbonization temperature increased, the surface of the resulting CMDB [Cow Manure Derived Biochar] roughened, and the number of internal pores increased." (Peizhen Zhang, 2019) Volatile components are gradually released from cow manure with the increase of temperature, resulting in improved pore structure. A larger specific surface area, larger pore volume, and smaller average pore diameter formed, contributing to improved adsorption performance (Ahmad, 2012)
        - The carbon content is not the only aspect of a biochar that indicated adsorption performance. "Oxygen-containing functional groups on the surface of the biochar can be used as receptors for binding phenolic hydroxyl groups, while carbonyl groups bind to it via H-bonds." (Peizhen Zhang, 2019)
        - The ash content is a strong indicator of biochar's pH and zeta potential. The higher pH values of biochar [from the ash content] promote pollutant adsorption onto biochar due to increasing electrostatic attraction (Jiaolong Qina, 2019)
        - Increased ash in biochar promotes heavy metal precipitation and complexation, therefore, increasing the adsorption capacity. (Zhang, 2017) The dissolved anions provided by minerals in the chars instead of mineral crystallization [e.g., SiO_2 and Al_2O_3] were much more readily able to participate in the formation of a co-precipitate. The Oxygen Functional Groups and Cation Exchange Capacity properties of the chars control the adsorption capacity (Yanfei Li, 2018)
        - The removal of heavy metals by biochar was directly correlated with the amount of oxygen-containing functional groups (Yan Wang, 2018)

- The ash content of Deionized Water washed slow pyrolyzed (350°C) Yak Manure Biochar was lower than non-washed resulting in reduced precipitation of tested pollutants because of decreased ash content. (Yan Wang, 2018)
- Oxygen Functional Groups (OFG) of chars were positively related to the Qm (precipitation, r=0.85), Qc (OFG complexation, r=0.880) and Q (Total sorption on chars, r=0.91). The Cation Exchange Capacity (CEC) is another key property of chars due to its highly positive relationship to the Qm (precipitation, r=0.95), Qi (ion exchange, r=0.99) and Q (Total sorption on chars, r=0.93) (Yanfei Li, 2018)
- The bioavailable heavy metal fraction in manures were transformed into the relatively stable fraction (oxidizable fraction) and very stable fraction (residual fraction) during pyrolysis (Hongmei Jin a, 2019)
- Total metal(loid) distribution in biochar produced from pyrolysis were retained in biochar (Hongmei Jin a, 2019)
- Higher surface area is good for metal(loid)s immobilization in [bio]chars (Hongmei Jin a, 2019)
- Livestock manure-derived biochar contains higher ash content, higher water-soluble salts, and higher potential cation exchange capacity than plant-derived biochar, which makes livestock manure-derived biochar an effective adsorbent for soil remediation. (Jiaolong Qina, 2019)
- The carboxylic acid groups and hydroxy groups on biochar surface have been reported to act as electron mediators, and the surface-oxygenated functional group and conductivity provide biochar with redox properties. The Environmental persistent free radicals (EPFRs) in biochar could induce the formation of reactive oxygen species ($^{\cdot}OH$) or directly degrade organic contaminants efficiently (Jiaolong Qina, 2019)



No.	Biochar Types	Reference
1	Corn straw biochar	(Chen et al., 2011b)
2	Orange waste biochar	(Pellera et al., 2012)
3	Rice husk biochar	
4	Olive pomace biochar	
5	Compost biochar	
6	Cow manure biochar	(Kołodyńska et al., 2012)
7	Pig manure biochar	
8	Dairy manure biochar	(Xu et al., 2013)
9	Hardwood biochar	(Chen et al., 2011b)
10	Peanut straw biochar	(Tong et al., 2011)
11	Soybean straw biochar	
12	Canola straw biochar	
13	Switchgrass biochar	(Han et al., 2013b)
14	Softwood biochar	
15	Pinewood biochar	(Liu et al., 2010)

1	Sugarcane bagasse biochar	(Inyang et al., 2011)
2	Raw sugarcane bagasse biochar	
3	Pig manure biochar	(Kołodyńska et al., 2012)
4	Cow manure biochar	
5	Pinewood biochar	(Mohan et al., 2007b)
6	Pinebark biochar	
7	Oak wood biochar	
8	Oak bark biochar	
9	Magnetic oak bark biochar	(Mohan et al., 2013)
10	Digested dairy waste char	(Inyang et al., 2012)
11	Sugar beet biochar	
12	Rice husk biochar	(Liu & Zhang, 2009)
13	Dairy manure biochar	(Cao et al., 2009)
14	Buffalo weed biochar	(Yakkala et al., 2013)

1	Corn straw biochar	(Chen et al., 2011b)
2	Pig manure biochar	(Kołodyńska et al., 2012)
3	Cow manure biochar	
4	Fruit branch magnetic char	(Mubarak et al., 2013)
5	Dairy manure biochar	(Xu et al., 2013)
6	switchgrass biochar	Han et al., 2013b)
7	hardwood biochar	
8	Softwood biochar	

1	Dairy manure biochar	(Xu et al., 2013)
2	Buffalo weed biochar	(Yakkala et al., 2013)
3	Rice straw biochar	(Han et al., 2013a)
4	Oak bark biochar	(Mohan et al., 2007b)
5	Pig manure biochar	Kołodyńska et al.,
6	Cow manure biochar	2012)

Fig. 2. Comparative evaluation of adsorbents for Cu^{2+}, Pb^{2+}, Zn^{2+} and Cd^{2+}.

In Figure above, dairy manure biochar, even containing ash, is a comparable absorbent for heavy metals (Dinesh Mohan, 2014)

14. A statement of beneficial effects to the environment, human health, or farm ecosystem from use of the synthetic substance that support its use instead of the use of a non-synthetic substance or alternative cultural method is not applicable to this petition.

References

Ahmad, M. L. (2012). Effects of pyrolysis temperature on soybean stover- and peanut shell-derived biochar. *Bioresource Technology*, 536-544.

Anna V. Piterina, J. K. (2017). Mutagenic activities of biochars from pyrolysis. *Science of the Total Environment*, 674-679.

Balal yousaf, G. L. (2017). Investigating the biochar effects on C-mineralization and sequestration of carbon in soil compared with conventional amendments using the stable isotope approach. *Global Change Biology Bioenergy*, 1085-1099.

Daniel A Bair, F. N. (2016). Sorption of Pharmaceuticals, Heavy Metals, and Herbicides to Biochar in the PResence of Biosolids. *Journal of Environmental Quality*, 1998-2006.

de Chen, X. L. (2018). Effects of biochar on availability and plant uptake of heavy metals - A meta-analysis. *Journal of Environmental Management*, 76-85.

Dinesh Mohan a, ⇑. A. (2014). Organic and inorganic contaminants removal from water with biochar, a renewable, low cost and sustainable adsorbent - A critical review. *Bioresource Technology*, 191-202.

Hongmei Jin a, b. D. (2019). Immobilization of metal(loid)s in hydrochars produced from digested swine and dairy manures. *Waste Management*, 10-20.

Hyun Min Jang, Y.-k. C. (2018). Effects of dairy manure-derived biochar on psychrophilic, mesophilic and thermophilic anaerobic digestions of dairy manure. *Bioresources Technology*, 927-931.

J.A. Ippolito, M. S. (2016). Hardwood biochar and manure co-application to a calcareous soil. *Chemosphere*, 84-91.

Javed Nawab, J. G. (2018). Minimizing the risk to human health due to the ingestion of arsenic and toxic metals in vegatbales by the application of biochar, farmyard manure and peat moss. *Journal of Environmental Management*, 172-183.

Jian Wang, E. S. (2019). Polyaromatic hydrocarbons in biochars and human health risks of food crops grown in biochar-amended soils: A synthesis study. *Environmental International*, 1-10.

Jian Wang, K. X. (2018). Application of biochar soils may result in plant contamination and himan cancer rish due to exposure of polycyclic aromatic hydrocarbons. *Environmental International*, 169-177.

Jiaolong Qina, S. Q. (2019). Cow manure-derived biochar: Its catalytic properties and influential factors. *Journal of Hazardous Materials*, 381-388.

Jie Jin, K. S. (2018). Isolation and characterization of biochar-derived organic matter fractions and their phenanthrene sorption. *Environmental Pollution*, 745-753.

Jun Meng, M. T. (2018). Changes in heavy metal bioavailability and speciation from a Pb-Zn mining soil amended with biochars from co-pyrolysis of rice straw and swine manure. *Science of the Total Environment*, 300-307.

M.A. Sanchez-Monedero, M. C. (2018). Role of biochar as an additive in organic waste composting. *Bioresource Technology* , 1155-1164.

Mayur Shirish Jain, S. P. (2019). Utilization of Biochar as an amendment during lignocellulose waste composting: impact on composting physics and Realization (probability) amongst physical properties. *Process Saety and Environmental Protection*, 229-238.

Mei Huang, Z. L. (2019). Application potential of biochar in environment: Insight from degradation of biochar-derived DOM and complexation of DOM with heavy metals. *Science of the Total Environment*, 220-228.

Meriem Belhachemi, B. K.-E. (2019). Characterization of biomass-derivied chars. In *Char and Carbon Materials Derived from Biomass* (pp. 1-40). Elsevier Inc.

Paulina Godlewska, H. P. (2017). Biochar for composting improvement and contaminants reduction. A review. *Bioresource Technolgy*, 193-202.

Peizhen Zhang, Y. L. (2019). Characteristics of tetracycline adsorption by cow manure biochar prepared at. *Bioresource Technology*, 1-37.

Qianli Ma, W. S. (2018). Physicochemical properties of biochar derived from anaerobically digested dairy manure. *Waste Management*, 729-734.

Sanaz Alizadeh, S. O. (2016). Effect of biochar on the fate and transport of manure-borne progesterone in soil. *Ecological Engineering*, 231-241.

Sarah E. Hale, J. L. (2012). Quanitifying the Total and Bioavailable Polycyclic Aromatic Hydrocarbons and Dioxins in Biochars. *Environmental Science & Technology*, 2830-2838.

Simeng Li, G. C. (2018). Thermogravimetric, thermochemical, and infrared spectral characterization of feedstocks and biochar derived at different pyrolysis temperatures. *Waste Management*, 198-207.

sujith Ravi, B. S. (2016). Particulate matter emissions from biochar-amended soils as potential tradeoff to the negative emission potential. *Scientific Reports*, 1-7.

Xiaochen Wei, D. L. (2018). Biochar addition for accelerating bioleaching of heavy metals from swine manure and reseving the nutrients. *Science of the Total Environment*, 1553-1559.

Xinyi Zeng, Z. X. (2018). Speciation and bioavailability of heavy metals in pyrolytic biochar of swine and goat manures. *Journal of Analytical and Applied Pyrolysis*, 82-93.

Yan Wang, R. L. (2018). H2O2 treatment enhanced the heavy metals removal by manure biochar in aqueous solutions. *Science of the Total Environment*, 1139-1148.

Yanfei Li, X. L. (2018). Qualitative and quantitative correlation of physicochemical characteristics and lead sorption behaviors of crop residue-derived chars. *Bioresource Technology*, 545-553.

Yasmin Khan Kiran, A. B.-q.-s.-e. (2017). Cow manure and cow manure-derived biochar application as a soil amendment for reducing cadmium availability and accumulation by Brassica chinensis L. in acidic red soil. *Journal of Integrative Agriculture*, 725-734.

Yinghong Yuan. Huaihai Chen, W. Y. (2017). Is biochar-manure co-composted a better solution for soil health improvement and N2O emissions mitigation? *Soil Biology & Biochemistry*, 14-25.

Zhang, C. S. (2017). Comparison of cadmium and lead sorption by Phyllostachy pubescens biochar produced under a low-oxygen pyrolysis atomosphere. *Bioresource Technology*, 352-360.

Appendix: Manure Derived Biochar Comments to NOSB

Background NOSB Information with comments from petitioner in blue.
Under the Organic Foods Production Act (OFPA) (7 U.S.C. 6501-6522), the National List of Allowed and Prohibited Substance section of the USDA organic regulations must include synthetic substances which are permitted for use in organic crop production, and non-synthetic (natural) substances which are prohibited for use in organic crop production. In NOP 5034-3, Published December 2, 2016 the following was stated about Biochar:
Biochar. We have amended the listing for biochar to clarify its description and use. We have eliminated the term "terra preta" in the description based on comments that indicated terra preta is carbon-rich soil but is not biochar itself. We have included the suggestion made by commenters to describe biochar as "biomass that has been carbonized or charred."
We have also replaced the term "feedstocks" with "sources," and included "animal material" as an allowed source, as requested by commenters. We have considered that the inclusion of "animal material" may raise questions about the allowance of manure as a feedstock for biochar, since the use of ash from manure burning is prohibited under section 205.602(a) of the USDA organic regulations. Although the pyrolysis process for biochar production is different than burning, we clarified in NOP 5033, Classification of Materials, that, for purposes of classification, pyrolysis may be treated as equivalent to burning or combustion. **Pyrolysis should not be treated as equivalent to burning or combustion. Pyrolysis is done in the absence of air/oxygen, whereas burning/combustion is done in the presence of large amounts of air/oxygen with an open flame. The ash from manure burning or combustion generally contains low volumes of carbon and nutrients due to volatilization and the resulting volume reduction. The "ash" from well controlled pyrolysis production of manure is contained in the biochar structure, with higher levels of carbon and nutrients.**

"(B)iochar is produced with the intent to be applied to soil as a means of improving soil productivity, carbon (C) storage or filtration of percolating soil water. …. In contrast to the organic C-rich biochar, burning biomass in a fire creates ash….. In contrast, the term 'burning' is typically used if no char remains, with the organic substrate being entirely transformed to ash that does not contain organic C. Often, substances called 'ash' in reality contain some char or biochar, significantly influencing ash properties and behavior in technology and the environment. Burning is very different from charring and pyrolysis, not only with respect to the solid ash residue versus biochar and related substances, but in terms of the gaseous products that are generated. Therefore, these two processes should be carefully distinguished from each other." (Biochar for Environmental Management Science and Technology, Edited by Johannes Lehmann and Stephen Joseph, 2009)

As the issue of biochar has not been considered by the NOSB, we are not providing clarification at this time on whether the use of biochar derived from manure is appropriate for organic production. Further, we have not amended the listing to specify "gasification" as production process for biochar. **The petitioner agrees with this decision. Gasification produces an ash that is not a biochar. Pyrolysis produces a biochar that is not an ash.**

This was suggested by a commenter to align with NRCS Conservation Practice Code 735 entitled "Waste Gasification Facilities." We have also not accepted the suggestion to reference the International Biochar Initiative (IBI) Standards or additional information on prohibited additives, such as specifying no more than 2% contaminants by dry weight, as is done under the IBI Biochar standards. We feel that this level of detail and prescriptive guidance would first need evaluation by the NOSB. Parties interested in further evaluation of biochar are encouraged to submit a petition to the NOSB according to the current National List petition guidelines so that this material may be further considered.

Ash from manure burning

§205.602 Nonsynthetic substances prohibited for use in organic crop production. The petitioner agrees that "ash" from manure "burning" should be prohibited for use in organic crop production. The petitioner does not agree that manure biochar production under controlled pyrolysis conditions is the same as "manure burning," and the petitioner does not agree that the nutrient "ash" product contained in manure biochar is the same as "ash from manure burning."

Reference: 205.602(a) **Ash from manure burning**.

Technical Report: none

Petition(s): 2014

Past NOSB Actions: 04/1995 NOSB minutes and vote; 11/2005 sunset recommendation; 10/2010 sunset recommendation, 10/2015 sunset recommendation; 4/2016 NOSB formal recommendation

Recent Regulatory Background: Sunset renewal notice published 06/06/12 (77 FR 33290); Renewed 03/15/2017 (82 FR 14420)

Sunset Date: 3/15/2022

Subcommittee Review:

Use: In some areas of nonorganic agriculture, the burning of manure to create an ash is used to lessen the volume of material (manure) transported to a field for fertilizer and to recover some of the nutrients in a more concentrated form (phosphorus, calcium, potassium and magnesium). The ash can then be used as a fertility input that is high in these nutrients. Large scale biochar manufacturing facilities claim that CAFOs can benefit from this manufacturing process, to lessen the impact of the volume of manure they need to dispose of from their facilities. This ash from manure has also been touted as a feed ingredient for livestock. The NOP organic standards do not allow re-feeding of manure to organic livestock.

Manufacture: Manure can be thermally decomposed through combustion to produce this ash. **The ash produced from combustion is not a biochar, and the biochar produced from pyrolysis is not an ash**

International: Canadian standards do not allow ash from manure burning to be used on organic crops. **Yes, and the petitioner agrees that ash from manure burning should not be used on organic crops.** The EU does not allow manure from confined animal operations to be used on organic crops. **Correct for raw manure; however, cow manure biochar contains many of the nutrients of the original raw manure. The nutrients may be considered stable but will be**

released over time depending on the application, pyrolysis conditions, etc.; void of pathogens; and, are a beneficial soil conditioner for organic crops. NOSB October 2019 proposals and discussion documents Page 97 of 230

Summary of Public Comment: The vast majority of public comment addressing this material agreed with a continued listing as a prohibited material. However, one commenter discussed the benefits of controlled pyrolysis burning to create a manure-based biochar as being a good way to avoid the negative effects of nutrient leaching and other issues dealing with large volumes of raw manure. This commenter discussed the special property of heavy metal soil remediation in contaminated soils of manure-based biochar, over plant-based biochar. This was the only comment that answered the Subcommittee's question in our first review:

"Does ash from manure burning supply nutrients or other benefits that cannot be obtained from any other material?" **The petitioner agrees with this one commenter and will demonstrate many other benefits of cow manure biochar that cannot be obtained from any other material in this petition**

Discussion: In April 2016, the NOSB responded to a petition to allow ash from manure burning with the following annotation: "except where the combustion reaction does not involve the use of synthetic additives and is controlled to separate and preserve nutrients". The petitioner stated they source manure from Concentrated Animal Feeding Operations (CAFOs) and use a staged thermochemical reactor to extract minerals from their poultry manure source. The NOSB stated the following to support their recommendation to keep this material, as listed, as a prohibited non-synthetic:

"Ash from manure burning was placed on §205.602 based on its incompatibility with organic production: "Burning these materials is not an appropriate method to recycle organic wastes and would not be considered a proper method in a manuring program because burning removes the carbon from these wastes and thereby destroys the value of the materials for restoring soil organic content. Burning as a disposal method of these materials would therefore not be consistent with section 2114(b)(1) of the OFPA (7 U.S.C. 6513(b)(1))." (Preamble to proposed rule, December 16, 1997. 62 FR 241: 65874)"

The USDA organic regulations require "soil-building" as a basic foundational principle, to improve soil tilth, water retention, nutrients and carbon sequestration. "§205.203 © *The producer must manage plant and animal materials to maintain or improve soil organic matter content…."* **This petition cites references that demonstrate cow manure biochar, produced under controlled pyrolysis conditions, is an appropriate method to recycle organic wastes into "soil building" conditioners that improve soil tilth, water retention, nutrients and carbon sequestration without "burning" off the carbon.**

Soil microbiological life increases when provided with carbon-based sources containing a variety of nutrients, and extraction of nutrients while destroying others (such as nitrogen) does not meet either the letter, nor spirit of the USDA organic law or regulations. **The petitioner agrees with this statement**

The current crop subcommittee agrees with the previous NOSB recommendation, and prefers manure retain its full carbon and nutrient content, when used as a fertility input on organic land. **The**

petitioner agrees with this statement and is pleased to report that well controlled pyrolysis of cow manure into biochar retains high volumes of carbon and nutrients of any thermochemical process

Subcommittee Vote: Motion to remove ash from manure burning from §205.602 of the National List based on the following criteria in the Organic Foods Production Act (OFPA) and/or 7 CFR 205.600(b): NA

Motion by: Harriet Behar
Seconded by: Jesse Buie
Yes: 0 No: 8 Abstain: 0 Absent: 0 Recuse: 0