Formal Recommendation by the
National Organic Standards Board (NOSB)
to the National Organic Program (NOP)

Date: **April 29, 2011**

Subject: **Petition- Adding nickel to the list of micronutrients found on the National List, 205.601(j)(6)(ii)**

Chair: **Tracy Miedema**

The NOSB hereby recommends to the NOP the following:

Rulemaking Action **X**
Guidance Statement
Other

Statement of the Recommendation (Including Recount of Vote):

Nickel to be added as a micronutrient to the list of micronutrients already included in §205.601(j)(6)(ii) was reviewed at NOSB at the April 2011 meeting following a petition for such use. The Crops Committee's recommendation is attached. At the April 2011 meeting there was discussion of environmental and human health concerns related to the material as well as the merits of the material for growers. A motion was made and seconded to classify nickel as a synthetic substance. The NOSB voted unanimously to classify nickel as a synthetic substance.

Rationale Supporting Recommendation (including consistency with OFPA and NOP):

See attached.

NOSB Vote: List nickel as a micronutrient on §205.601(j)(6)(ii)

Moved: John Foster		Second: Tina Ellor		
Yes: 5	No: 9	Abstain: 0	Absent: 2	Recusal: 0

NOSB COMMITTEE PROPOSED RECOMMENDATION

Form NOPLIST1. Committee Transmittal to NOSB

For NOSB Meeting: Spring 2011—Seattle, WA	Substance: Nickel as a micronutrient, added to 205.601(j)(6)(ii)

Committee: Crops X Livestock ☐ Handling ☐ Petition is for: Adding nickel to the list of micronutrients found on the National List, 205.601(j)(6)(ii)

A. Evaluation Criteria (Applicability noted for each category; Documentation attached) **Criteria Satisfied? (see B below)**

1. Impact on Humans and Environment — Yes ☐ No **X** N/A ☐
2. Essential & Availability Criteria — Yes ☐ No **X** N/A ☐
3. Compatibility & Consistency — Yes ☐ No **X** N/A ☐
4. Commercial Supply is Fragile or Potentially Unavailable as Organic (only for 606) — Yes ☐ No ☐ N/A **X**

Substance Fails Criteria Category: 1, 2, 3 Comments: Fails categories.. Annotation in place for other micronutrients already on the list and--under which nickel would also be limited--is intended to mitigate effects of micronutrient use.

Proposed Annotation:
§ 205.601 Synthetic substances allowed for use in organic crop production.
(j) As plant or soil amendments.
(6) Micronutrients—not to be used as a defoliant, herbicide, or desiccant. Those made from nitrates or chlorides are not allowed. Soil deficiency must be documented by testing.
(i) Soluble boron products.
(ii) Sulfates, carbonates, oxides, or silicates of zinc, copper, iron, manganese, molybdenum, nickel, selenium, and cobalt.

Basis for annotation:
To meet criteria above: 1, 2, 3. Criterion: Compatibility & consistency—to minimize the likelihood to overdependence on supplemental synthetic crop fertility practices in lieu of soil building practices as mandated in § 205.203.

B. Recommended Committee Action & Vote, including classification recommendation (State Actual Motion): Classify nickel micronutrients as synthetic.

C. Classification of the material: Synthetic 5 Non- synthetic 0 Absent 2 Abstain 0

Motion by: John Foster Seconded Jay Feldman Yes: 5 No: 0 Absent 2 Abstain: 0

Recommended Committee Action & Vote List nickel as micronutrient on § 205.601(j)(6)(ii)

Motion by: John Foster Seconded: Tina Ellor Yes: 2 No: 3 Absent: 2 Abstain: 0

Crops	**X**	Agricultural		Allowed[1]	
Livestock		Non-Synthetic		Prohibited[2]	
Handling		Synthetic	**X**	Rejected[3]	x
No restriction		Commercially Un-Available as Organic[1]		Deferred[4]	

1) Substance voted to be added as "allowed" on National List to § 205._____with Annotation (if any) _____

2) Substance to be added as "prohibited" on National List to § 205._____with Annotation (if any) _____

Describe why a prohibited substance:_____

3) Substance was rejected by vote for amending National List to § 205 601(j)(6)(ii) Describe why material was rejected:

Concerns over toxicity, carcinogenicity, essentiality, and use pattern (spray into tall canopy) by those voting in the majority..

4) Substance was recommended to be deferred because _____

If follow-up needed, who will follow up _____

E. Approved by Committee Chair to transmit to NOSB:

John Foster — **Committee Chair**

April 29, 2011 — **Date**

EVALUATION CRITERIA FOR SUBSTANCES ADDED TO THE NATIONAL LIST

Category 1. Adverse impacts on humans or the environment?
Substance: Nickel (added to list of other micronutrients currently included on the National List)
(RPet=Revised Petition; TR=Technical Review)

Question	Yes	No	N/A[1]	Documentation (TAP; petition; regulatory agency; other)
1. Are there adverse effects on environment from manufacture, use, or disposal? [§205.600 b.2]			x	
2. Is there environmental contamination during manufacture, use, misuse, or disposal? [§6518 m.3]	x			The precise amount of nickel destined for agricultural use is unknown, but is known to be a fraction of 7% of nickel smelted and manufactured. 'Agricultural use' did not register as a subcategory within the use category "chemicals and chemical use", suggesting that nickel for micronutrient use is an exceedingly small fraction of the total in play. RPet 9c. TR lines 459+, 671+ Surface mining involves large disturbance by earth-moving equipment. Nickel is no longer produced in US, so must be imported. Refining is very energy intensive. People around refineries are exposed to toxic nickel dust and sulfur dioxide.TR 422-457
3. Is the substance harmful to the environment? [§6517c(1)(A)(i);6517(c)(2)(A)i]	x			When used as intended in this context, possibly but apparently not likely; the TR identifies certain harmful environmental effects outside of the use of nickel as a micronutrient in organic production systems. RPet 9c, 9e. TR lines 474, 484, 489+. Listed as a Hazardous Constituent of Waste (nickel, nickel compounds, nickel carbonyl, nickel cyanide) (305-306) On the other hand, these components, such as Cu, Zn, Ni, Co, Mo, Fe, and Mn, are also termed as "heavy metals". The contamination of these heavy metals to the environment is well documented. It is a situation of case by case analysis, but the contamination problem such as the contamination of nickel in old orchard where fertilizers have been used extensively might be more general than the deficiency problem (e.g. U.S. EPA's Background report on fertilizer use, contaminants and regulations; U.S. EPA's Nutrient Management and Fertilizer; and USDA's Heavy Metal Soil Contamination). (489-495) The toxicity effect of one component could be enhanced by another component. For example, scots pine (*Pinus sylvestris* L.) saplings did not survive when individually treated with 150 mg L^{-1} of copper or 150 mg L^{-1} of nickel. The lethal concentration substantially reduced to 15 mg L^{-1} each when these two components were applied simultaneously (Nieminen, 1998). (521-524)

				"Although Ni is a recognized essential mineral nutrient element for higher plants, its agricultural and biological significance is poorly understood. This is largely because of the low levels thought to be needed by plants (about 1–100 ng g^{-1} dry weight) in relation to the relative abundance of Ni in essentially all soils (> 5 kg ha^{-1})," (Bai et al., 2006 and additional references cited therein). (584-587)
4. Does the substance contain List 1, 2, or 3 inerts? [§6517 c (1) (B)(ii); 205.601(m)2]	**?**			Unknown Some micronutrients are chelated compounds such as chelates of citric acid, lignosulfonic acid, various amino acids, HEDTA (hydroxyethylenediaminetriaacetic acid), EDTA (ethylenediaminetetraacetic acid), and DTPA (diethylenetriaminepentaacetic acid). (97-99) Check to see if any are List 1,2, 3. Some are 4B, which likely will not be allowed in the future.
5. Is there potential for detrimental chemical interaction with other materials used? [§6518 m.1]	**x**			If misused, excessive nickel application could result in detrimental effects, particularly by causing imbalances with other micronutrients. RPet 9a. TR lines 513
6. Are there adverse biological and chemical interactions in agro- ecosystem? [§6518 m.5]	**x**			If misused, levels above those required for plant growth and crop production can cause problems. Toxicity can occur when micronutrients are applied in excess. RPet 9. TR lines 534, 545+ When micronutrients are applied as chelates, some chelating agents such as ETDA are synthetic but do not naturally exist in soil. Potentially, these chelating agents may cause the loss of other components in soil by complexing those components and making those components soluble in water. (484-487)
7. Are there detrimental physiological effects on soil organisms, crops, or livestock? [§6518 m.5]	**x**			The TR does not note such effects when nickel is used appropriately as a micronutrient, though does suggests that possibility when misused, that is provided in excess of need. RPet 9. TR lines 560-651. The TR does not address impacts on the soil foodweb, but numerous studies show negative impacts on soil respiration and the growth of soil fungi, including mycorrhizal fungi. (Addendum)
8. Is there a toxic or other adverse action of the material or its breakdown products? [§6518 m.2]	**x**			See #7 above. Nickel is active in the Ni cation and does not break down further. TR lines 661+. RPet 9, 10. Nickel is toxic and carcinogenic, it can be phytotoxic TR 489-495, 513-524, 545-555, 608-612
9. Is there undesirable persistence or concentration of the material or breakdown products in environment?[§6518 m.2]	**x**			When used correctly, the TR notes no such effects. The TR does reference a line from ATSDR-Ni in line 705 stating that, "…it is impossible to predict nickel's environmental behavior on a general basis." Nickel is a heavy metal. Contamination can be a problem, worse than deficiency, and interact

				with other metals. TR 489-495, 513-524
10. Is there any harmful effect on human health? [§6517 c (1)(A) (i) ; 6517 c(2)(A)I; §6518 m.4]	**x**			Human health effects were addressed in the TR in general terms, but not in the context of nickel used as a micronutrient. Occupational hazards and exposures of the general public to nickel did not include mention of nickel as a micronutrient. For example, "The general population is exposed to low levels of nickel because it is widely present in air, water, food, and consumer products." TR lines 816-817. RPet 9d, 10 Nickel compounds are known to be human carcinogens (ATSDR-Ni, 2005; 11th Report on Carcinogens – Nickel Compounds and Metallic Nickel). (782-783) The effect of nickel on human health is extensively discussed in ATSDR-Ni (2005). Nickel compounds "can be grouped according to their solubility in water: soluble compounds include nickel chloride, nickel sulfate, and nickel nitrate, and less-soluble compounds include nickel oxide and nickel subsulfide. Both the soluble and less-soluble nickel compounds are important with regard to all relevant routes of exposure. Generally, the soluble compounds are considered more toxic than the less-soluble compounds, although the less-soluble compounds are more likely to be carcinogenic at the site of deposition." (785-791)
11. Is there an adverse effect on human health as defined by applicable Federal regulations? [205.600 b.3]			**x**	
12. Is the substance GRAS when used according to FDA's good manufacturing practices? [§205.600 b.5]			**x**	
13. Does the substance contain residues of heavy metals or other contaminants in excess of FDA tolerances? [§205.600 b.5]			**x**	

[1] If the substance under review is for crops or livestock production, all of the questions from 205.600 (b) are N/A—not applicable.

Category 2. Is the Substance Essential for Organic Production?
Substance: Nickel (added to list of other micronutrients currently included on the National List)

Question	Yes	No	N/A[1]	Documentation (TAP; petition; regulatory agency; other)
1. Is there a natural source of the substance? [§205.600 b.1]			x	
2. Is there an organic substitute? [§205.600 b.1]			x	
3. Is the substance essential for handling of organically produced agricultural products? [§205.600 b.6]			x	
4. Is there a wholly natural substitute product? [§6517 c (1)(A)(ii)]	x			None are available for rapid correction of micronutrient deficiencies or in soluble form. TR 867-882 Alyssum extracts are as efficacious as nickel sulfate in correcting or preventing Ni deficiency. Wood et al, 2006.
5. Is the substance used in handling, not synthetic, but not organically produced? [§6517 c (1)(B)(iii)]			x	
6. Is there any alternative substances? [§6518 m.6]	x			There are some plants that tend to accumulate nickel and other micronutrients when grown in appropriate conditions. TR 887-912 pH adjustment might be more important than applying "required" micronutrients for correcting "deficiency" problems. "If the deficiency is due to pH imbalance, the approach is to modify the pH of the mix. In this case, adding micronutrients can make matters worse because the level of individual micronutrients may affect the level in the plant of other micronutrients through a process called antagonism. For example, too much iron may produce manganese and zinc deficiencies, while high levels of manganese may result in iron and zinc deficiencies. Copper and zinc are also antagonistic: too much of one may produce deficiency of the other," (Ohio State University). Heavy metals such as Cu, Zn and Ni are strongly retained in soil. Excessively applied micronutrients remain in soil for a long time and may cause toxic effects to subsequent plants. (948-957
7. Is there another practice that would make the substance unnecessary? [§6518 m.6]	x			Subject to the Law of the Minimum and in the some cases, yes. A healthy soil can provide sufficient micronutrients to some crops in some cases, although the dynamics of soil properties are such that micronutrient deficiencies can be found in crops even though soil micronutrient levels appear to be adequate. TR 584+, 594+. RPet 1, 4, 12. "Although Ni is a recognized essential mineral nutrient element for higher plants, its agricultural and biological significance is poorly understood. This is largely because of the low levels thought to be needed by plants (about 1–100 ng g^{-1} dry weight) in relation to

				the relative abundance of Ni in essentially all soils (> 5 kg ha^{-1})," (Bai et al., 2006 and additional references cited therein). (584-587) The nickel deficiency was especially evident in ureide-transporting woody perennials such as pecan tree (Wood et al., 2006; Bai et al., 2006). One cause of nickel deficiency is the suppressed nickel uptake by the excessive presence of zinc (University of Georgia). The metabolic consequence of nickel deficiency was the accumulation of urea, disrupted metabolism of amino acids, and reduced urease activity. The morphological symptoms of nickel deficiency in a woody perennial were dwarfing of leaves and leaflets with respect to healthy leaves, i.e. so called mouse ear in pecan (Wood et al., 2004; Bai et al., 2006; University of Georgia). (594-600)

[1] If the substance under review is for crops or livestock production, all of the questions from 205.600 (b)are N/A—not applicable.

Category 3. Is the substance compatible with organic production practices?
Substance: Nickel (added to list of other micronutrients currently included on the National List)

Question	Yes	No	N/A[1]	Documentation (TAP; petition; regulatory agency; other)
1. Is the substance compatible with organic handling? [§205.600 b.2]			x	
2. Is the substance consistent with organic farming and handling? [§6517 c (1)(A)(iii); 6517 c (2)(A)(ii)]		X		Applications of synthetic micronutrients have been consistent with organic farming practices for over 30 years. Nickel is now recognized as an essential micronutrient. TR 54+, 101+, 184+, 228+, revised petition part 6, AAPFCO, professional knowledge, pre-NOP private standards, and 7 CFR 205. RPet 12 Negative impact on soil organisms. (See citations in addendum.)
3. Is the substance compatible with a system of sustainable agriculture? [§6518 m.7]		x		See #2 above. In the long run (and that's what "sustainable" means), it doesn't work to mine metals and add them to soils to grow crops that could be grown in other places.
4. Is the nutritional quality of the food maintained with the substance? [§205.600 b.3]			x	
5. Is the primary use as a preservative? [§205.600 b.4]			x	
6. Is the primary use to recreate or improve flavors, colors, textures, or nutritive values lost in processing (except when required by law, e.g., vitamin D in milk)? [205.600 b.4]			x	
7. Is the substance used in production, and does it contain an active synthetic ingredient in the following categories: a. copper and sulfur compounds;	x			In the nickel sulfate (most common) form.
b. toxins derived from bacteria;		x		
c. pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and minerals?	x			Minerals.
d. livestock parasiticides and medicines?		x		
e. production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleaners?		x		

[1] If the substance under review is for crops or livestock production, all of the questions from 205.600 (b) are N/A—not applicable.

Category 4. Is the commercial supply of an agricultural substance as organic, fragile or potentially unavailable? [§6610, 6518, 6519, 205.2, 205.105 (d), 205.600 (c) 205.2, 205.105 (d), 205.600 (c)]
Substance: Nickel (added to list of other micronutrients currently included on the National List)

Question	Yes	No	N/A[1]	Documentation (TAP; petition; regulatory agency; other)
1. Is the comparative description provided as to why the non-organic form of the material /substance is necessary for use in organic handling?			x	
2. Does the current and historical industry information, research, or evidence provided explain how or why the material /substance cannot be obtained organically in the appropriate **form** to fulfill an essential function in a system of organic handling?			x	
3. Does the current and historical industry information, research, or evidence provided explain how or why the material /substance cannot be obtained organically in the appropriate **quality** to fulfill an essential function in a system of organic handling?			x	
4. Does the current and historical industry information, research, or evidence provided explain how or why the material /substance cannot be obtained organically in the appropriate **quantity** to fulfill an essential function in a system of organic handling?			x	
5. Does the industry information provided on material / substance non-availability as organic, include (but not limited to) the following: a. Regions of production (including factors such as climate and number of regions);			x	
b. Number of suppliers and amount produced;			x	
c. Current and historical supplies related to weather events such as hurricanes, floods, and droughts that may temporarily halt production or destroy crops or supplies;			x	
d. Trade-related issues such as evidence of hoarding, war, trade barriers, or civil unrest that may temporarily restrict supplies; or			x	
e. Are there other issues which may present a challenge to a consistent supply?			x	

Addendum
Some Studies of the Impacts of Nickel on Aspects of the Soil Food Web

1. Inhibition of growth of nine ectomycorrhizal fungi by cadmium, lead, and nickel *in vitro* ☆

J.D. McCreight[†, a] and D.B. Schroeder[a]
[a]Department of Natural Resources Conservation University of Connecticut, Storrs, CT 06268, U.S.A.
Received 18 February 1979;
revised 7 January 1980;
accepted 24 April 1980.
Available online 26 June 2003.

Abstract
Growth of *Amanita muscaria, Cenococcum graniforme, Laccaria laccata, Pisolithus tinctorius, Rhizopogon roseolus, Suillus brevipes, S. grevellei, S. luteus*, and *Thelephora terrestris* on Hagem Nutrient Agar as modified by Modess at 20°C for 28 days was inhibited by cadmium, lead, and nickel. All fungi were arrested by 350 μg cadmium per ml (ppm) or less. Lead arrested five species at 200 ppm or less; *Cenococcum graniforme, L. laccata*, and *S. luteus* were arrested at 2,000 ppm lead. Nickel arrested growth of six fungi at 20 ppm or less. *Amanita muscaria, S. luteus*, and *L. laccata* were arrested at 40, 175 and 225 ppm nickel, respectively. Metal concentrations that did not arrest delayed growth for 7–21 days after which the growth rate was comparable to the control.
☆Scientific Contribution No. 791, Agricultural Experiment Station, University of Connecticut, Storrs, CT 06268, U.S.A.

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Environmental and Experimental Botany
Volume 22, Issue 1, February 1982, Pages 1-7

2. Nickel toxicity to fungi: Influence of environmental factors

H. Babich and G. Stotzky
Laboratory of Microbial Ecology, Department of Biology, New York University, 952 Brown Building, Washington Square, New York, New York 10003, USA
Received 13 May 1982.
Available online 16 December 2004.

Abstract
The toxicity of nickel (Ni) to the mycelial growth rates of filamentous fungi was influenced by environmental abiotic factors. Increasing the pH from acidic to alkaline levels completely eliminated the toxicity of Ni to *Achyla* sp. and *Saprolegnia* sp. Magnesium or zinc, but not potassium, sodium, calcium, or ferric, ions reduced the toxicity of Ni to *Achyla* sp. An antagonistic interaction between a combination of Ni + Pb was noted toward growth of *Achyla* sp. and *Saprolegnia* sp.; the interactions between combinations of Ni + Cd or Ni + Hg were less well defined. Chlorophyll, at 1%, reduced the toxicity of Ni toward *Saprolegnia* sp. and *Cunninghamella blakesleeana*, and increasing the chlorophyll concentration from 0.2 to 1% progressively reduced the toxicity of Ni to *Aspergillus clavatus*. The addition of 1% humic acid reduced the toxicity of Ni to *Saprolegnia* sp. and *C. blakesleeana*, and increasing the humic acid concentration from 0.2 to 1% progressively reduced the toxicity of Ni toward *Aspergillus flavus. A. flavus* was more resistant to Ni at 33 than at 23°C.

3. Short-term and long-term effects of cadmium, chromium, copper, nickel, lead and zinc on soil microbial respiration in relation to abiotic soil factors

P. Doelman and L. Haanstra

Abstract

The inhibition of the respiration rate by the heavy metals, Cd, Cr, Cu, Pb, Ni and Zn was investigated in five Dutch soil types in relation to the length of time these heavy metals were present in the soil. The amounts of heavy metal added as chloride salts to the soils were 0, 55, 150, 400, 1000, 3000 and 8000 $\mu g \cdot g^{-1}$, respectively. The measurements were carried out both immediately after the addition of the heavy metals and approximately 18 months later. The inhibition during the first two to eight weeks was not obscured by an extra nutrient flush to drying. During the 18 months, the toxicity decreased but was still significant. Inhibition was greatest in the sandy soil and least in the clay soil. In a loam soil and in a sandy peat soil, the inhibiting effects were intermediate, but distinct. The main abiotic factors responsible for these different degrees of inhibition were the clay fraction for Cd, the Fe content for Cu, Pb and Zn and the pH for Ni. Although clay, Fe, and Mn together with the organic matter fraction, determine the total cation exchange capacity of soil, their contribution to the toxicity of heavy metals may be antagonistic. The latter may increase the mobility due to chelation and therefore possibly increase the toxicity, while the other factors may bind the heavy metals and therefore decrease the toxicity.

Key words Cd - CEC - Clay - Cr - Cu - Fe - Long-term - Mn - Ni - Organic matter - Pb - pH - Short-term - Soil microbial respiration – Zn

Use of Alyssum extracts to correct Nickel Deficiency

B.W. Wood, R. Chaney, and M. Crawford, 2006. Correcting Micronutrient Deficiency Using Metal Hyperaccumulators:*Alyssum* Biomass as a Natural Product for Nickel Deficiency Correction. HORTSCIENCE 41(5):1231-1234. 2006.

Abstract:

The existence of nickel (Ni) **deficiency in certain horticultural crops meritsdevelopment of fertilizer products suitable for specific niche uses and for correcting orpreventing deficiency problems before marketability**, **and yields are affected. The efficacyof satisfying plant nutritional needs for Ni using biomass of Ni hyperaccumulator specieswas assessed. Aqueous extraction of *Alyssum murale* (Waldst.** & **Kit.) biomass yieldeda Ni-enriched extract that, upon spray application, corrects and prevents Ni deficiency inpecan** ICaiya *illinoinensis* **(Wangenh.)** K. **Kochi. The *Ni-Alyssum* biomass extract** was aseffective at correcting or preventing Ni deficiency as was a **commercial Ni-sulfate salt.Foliar treatment of pecan with either source at -10 mg-L` Ni, regardless of source,prevented deficiency symptoms whereas treatment at less than 10 mg-L` Ni was onlypartially effective. Autumn application of Ni to foliage at 100 mg-L-' Ni during leafsenescence resulted in enough remobilized Ni to prevent expression of morphologicallybased Ni deficiency symptoms the following spring. The study demonstrates that micro-nutrient deficiencies are potentially correctable using extracts of metal-accumulatingplants.**