



DEPARTMENT OF
ECOLOGY
State of Washington

Understanding the Agronomic Rate of Application

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Agronomic Rate of Application

The rate of biosolids application that will supply the amount of nutrient needed to achieve the crop yield goal and be protective of the environment.

- For our purposes it's about nitrogen, but can apply to phosphorous, lime, boron, sulfur etc.
- The agronomic rate may (will likely) be different for two sources of biosolids.
- The nutrient need of the same crop may be different on different sites.

Nitrogen is Dynamic

- It transforms
 - Moves from soils to plants to the atmosphere – back and forth on multiple pathways
- Beyond a point, more is not better
 - Diminishing return
 - Too much N can pose a risk to groundwater
 - Too much N can limit future applications

What Kind of Nitrogen is in Biosolids & Soils?

- Mineral nitrogen – plant available
 - NH₃ Ammonia
 - NH₄⁺ Ammonium
 - In solution there is a pH dependent equilibrium between NH₃ and NH₄⁺
 - In soils, transformation from ammonia to ammonium is fairly rapid
- Organic nitrogen – not plant available
 - Total Kjeldahl Nitrogen *minus* ammoniacal N (biosolids, not soils)
 - In soils, contributed from soil organic matter and biosolids applications
 - Some mineralization every year

Residual Mineral Nitrogen

- What is left over after harvest
- Residual soil ammonium (→ nitrate if not used)
- Residual nitrate
 - Potentially subject to leaching
 - Implications different for west side and east side
- Evaluate success based on residual mineral nitrogen and crop yield
- Account for any discrepancies in next crop cycle

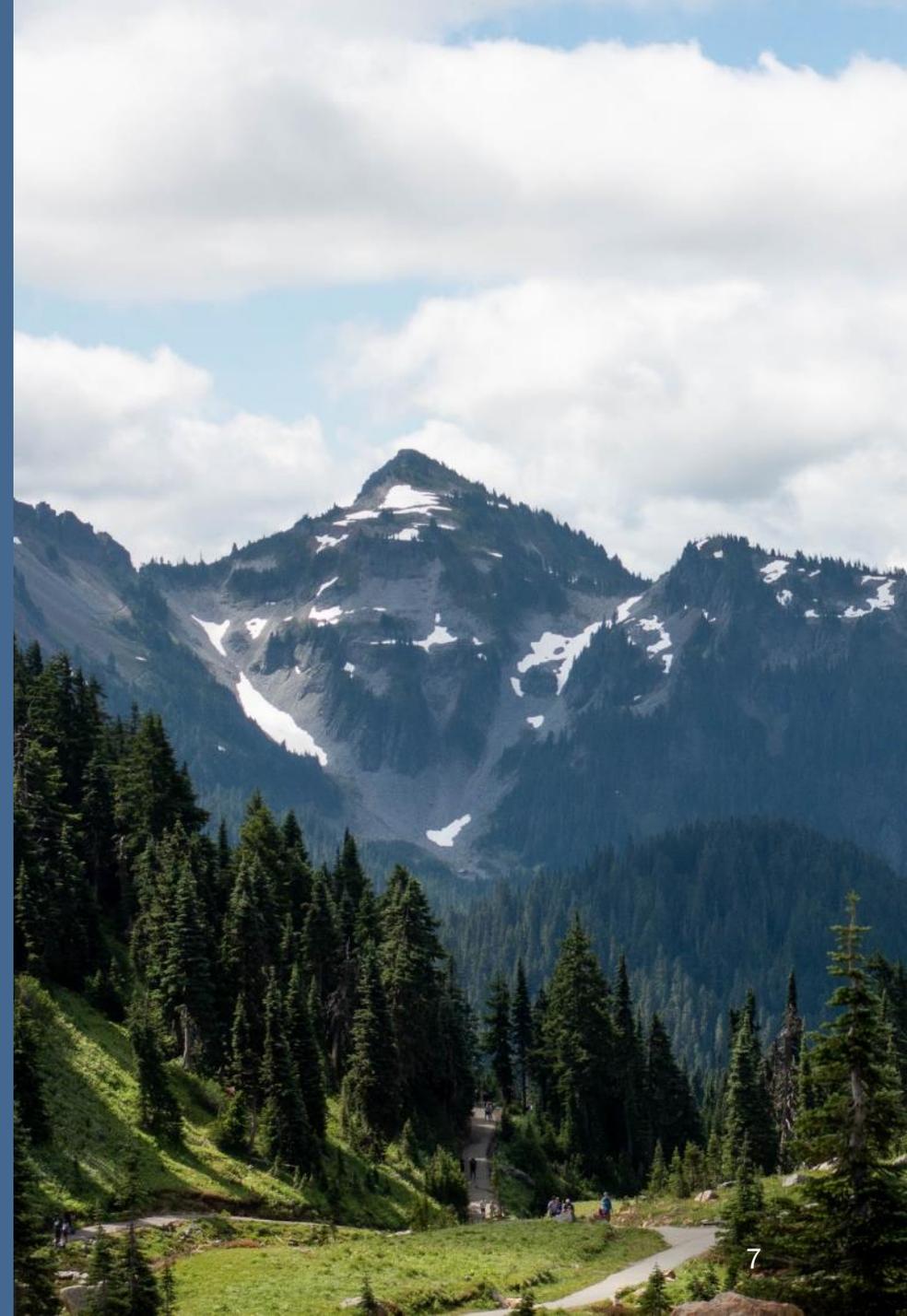
Calculating the Agronomic Rate of Application – what you need

- Plant Available Nitrogen Requirement (PAN)
 - Get from fertilizer guide, crop advisor, agronomist, soil scientist or other qualified source
- Biosolids nitrogen
 - Lab results of representative samples
- Field Assumptions
 - Mineralization
 - Volatilization
- Soil nitrogen
 - Lab results of representative samples



Calculating

<https://puyallup.wsu.edu/soils/biosolids/>



NOTE: This is adapted from Pacific Northwest Extension publication number, PNW0511e.

Enter information in these cells as applicable

You must enter information in these cells to determine an application rate

Cells of this color are calculations for your use

Version 20-Dec-07

GENERAL INFORMATION

Biosolids Source	El Dorado	
Field Number/ID	1	
Dry tons biosolids available (= wet tons x % solids)	500	dry tons
Acres available	100	acres

BIOSOLIDS DATA

Ammonia/ammonium-N	5,000	mg/kg	10	#/dry ton
Nitrate-N	100	mg/kg	0	#/dry ton
Total Kjeldahl N	40,000	mg/kg	80	#/dry ton
Percent solids	20%			
Organic nitrogen	35,000	mg/kg	70	#/dry ton

With 55% retention 5.5

With 35% mineralization 24.5

30 lbs from biosolids

NITROGEN (N) CREDITS

PREVIOUS BIOSOLIDS APPLICATIONS	Last Year	2 Years Ago	3 Years Ago	4 Years Ago
Dry tons applied/acre to site		5		
Organic N concentration (mg/kg)		40,000		
N credit (#/dry ton)	0	2	0	0
N credit (#/acre)	0	12	0	0

From past application 12

OTHER CREDITS NOT ACCOUNTED FOR

Nitrate-N applied in irrigation water	0	#/acre	
N applied at seeding (starter fertilizer)	0	#/acre	
Preplant nitrate-N in root zone (east of Cascades)	20	#/acre	NOTE: not required if accounted for in the nitrogen recommendation in Cell B30
Plowdown of cover or green manure crop	0	#/acre	NOTE: not required if accounted for in the nitrogen recommendation in Cell B30
Previous manure applications	0	#/acre	NOTE: not required if accounted for in the nitrogen recommendation in Cell B30
Total N credit	32	#/acre	

From soil tests 20

From past application and residual N

32

Other sources

NITROGEN FERTILIZER RECOMMENDATION

Nitrogen recommendation (via guidelines, agronomist, etc.)	150	# N/acre/yr
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ESTIMATED BIOSOLIDS PLANT-AVAILABLE NITROGEN

Percent of ammonium-N retained after application (see Table 1)	55%	
Percent of organic N mineralized in Year 1 (see Table 2)	35%	
Estimated plant-available N in biosolids	30	# N/dry ton
Amount of plant-available N needed from biosolids	118	# N/acre

From Biosolids Data Above	30 # per dry ton
Need (150) minus other sources	118

AGRONOMIC BIOSOLIDS APPLICATION RATE

Dry tons per acre =	3.9	dt/acre
Wet tons per acre =	19.5	wt/acre
Cubic yards per acre =	23.2	yd ³ /acre
Cubic feet per acre =	627.7	ft ³ /acre
Gallons per acre =	4,695.5	gallons/acre
Acre-inches per acre	0.17	acre-inches/acre

ACREAGE NEEDED

Acres needed	128.0	acres
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Not enough acres

Considerations

- Outcome depends on:
 - Reliable soils and biosolids data
 - Reliable information on PAN need and yields
 - Assumptions about mineralization and volatilization
 - Consideration of other inputs
- Use a reliable publication or professional source to determine PAN
- Have and use a good sampling and analysis plan
- Pay attention and know your partner
- Be diligent – check and adjust