Soil Preparation and pH Management for Blueberries

Mark Gaskell
Farm Advisor

UC Cooperative Extension
Santa Maria

Background / Overview

- *Traditionally – blueberries not grown in California*
  - *soil pH*
  - *chill requirement*

- *Blueberries now successfully being grown in California – early season market prices. Several key management components include:*
  - *soil management – especially pH modification*
  - *variety selection*
  - *cultural practices*

- *Soil and water acidification important to soil management*

pH and Blueberries

- *Principal problem is pH induced Fe deficiency*
- *Fe is complexed and unavailable at high pH*
- *Low Fe or high P competes for uptake*
- *Chelates may be used to correct problem short term.*

Special soil management required for success with blueberries

- *Traditional blueberry soils are sandy with low organic matter and pH 4.5 – 5.0*
- *Soils with higher OM Can tolerate pH somewhat outside of range pH 3.8-5.5 .*
- *Additional problems related to poor drainage, heavy soils, or drought. Generally impractical to modify high CEC soil*
  - *historically, > 2000 # Ca/ A; or 1.5 -2 meq bicarbonate or CEC = 18 as cut off*

<u>But S is cheap and blueberry fruit is $$</u>

pH and Blueberries

- *Principal problem is pH induced Fe deficiency*
- *Fe is complexed and unavailable at high pH*
- *Low Fe or high P competes for uptake*
- *Chelates may be used to correct problem short term.*

Bicarbonates - general

- *Bicarbonates and carbonates are salts in soils and water at high pH.*
  - *nutrient availability*
  - *plugging of irrigation lines*
  - *soil crusting due to Ca tie-up*
- *Generally carbonates in water with pH above 7 but those above 7 may or may not need treatment.*
- *Soil and water tests used to calculate total carbonates.*
- *Reported as ppm, mg/l or meq/l*
  ppm = mg/l = equivalent wt X meq/l

Treating Bicarbonate Problems

- Apply acid to soil or water
- $2HCO_3 + H_2SO4 \longrightarrow SO_4 + 2H_2O + CO_2$
- High bicarbonate and high CEC (soil) means high capacity to buffer pH changes and soil or water resists changing pH. Need to keep adding until buffer capacity is satisfied.
- Irrigation in concentrated area (as sand) with high carbonate water at high volume will aggravate high bicarbonate situation - do not over irrigate.

Soil pH Adjustment

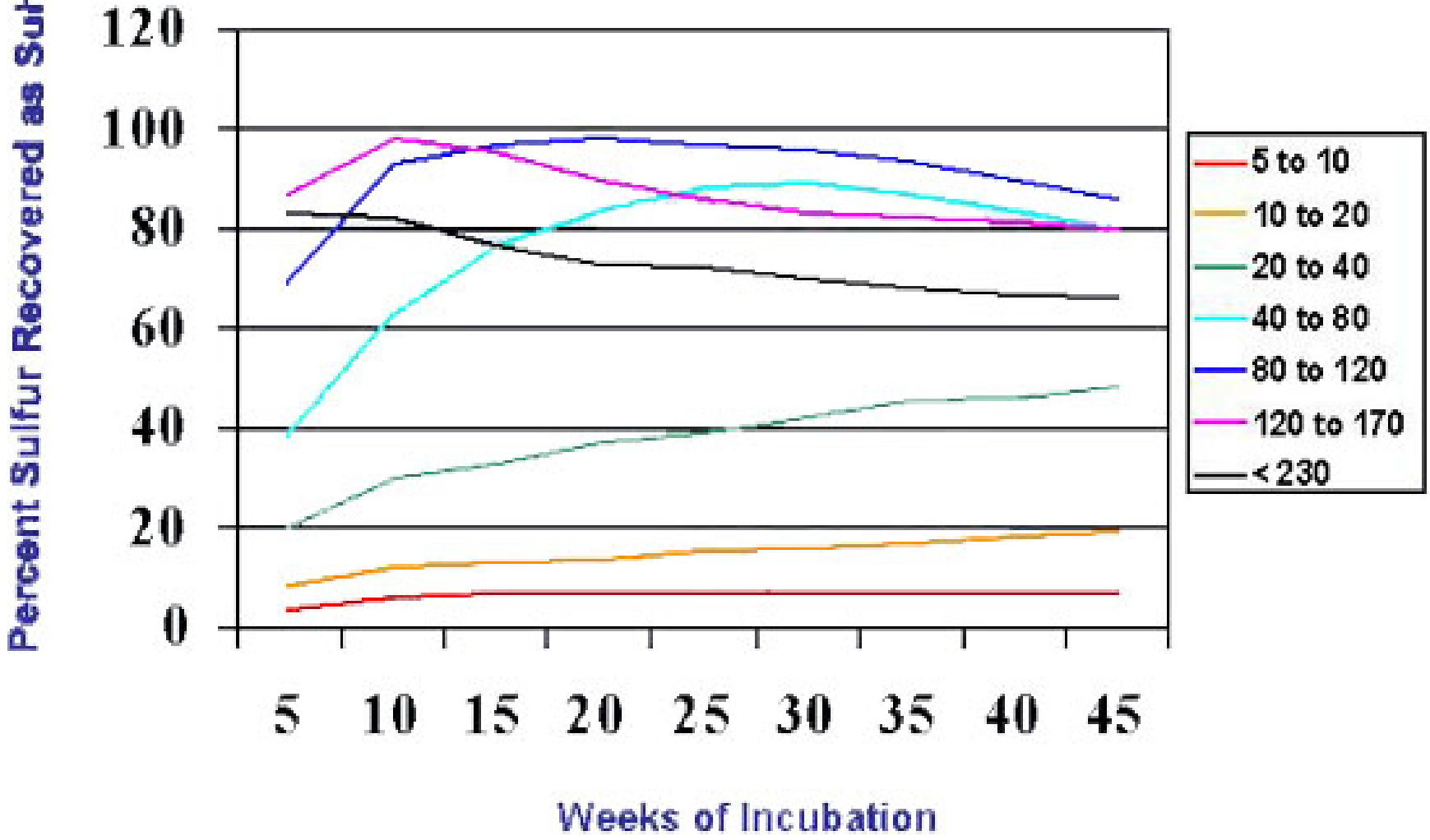
- Application of elemental sulfur to soils forms sulfuric acid and lowers the pH of the soil.
- $2S + 3O_2 + 2H_20 \xrightarrow{\text{bacteria}} 2\ H_2SO_4$
- Highly buffered, calcareous soils will resist a change in pH but can be acidified if enough acid is applied.
- Acidifying irrigation water will be effective in lowering the pH on weakly buffered soils. Also to counteract water bicarbonates.
- Apply acids to soil to counteract high bicarbs in water

Approximate amount of S required to lower Soil pH to 4.5 (lb / A)

	SOIL TYPE		
Current pH	Sand	Loam	Clay
5.0	175	530	800
5.5	350	1050	1600
6.0	530	1540	2310
6.5	660	2020	3030
7.0	840	2550	3830
7.5			

Apply S to soil as sulfuric acid, Tiger S, or Dispersul

Effect of particle size on recovery of sulfur added to a silt loam soil at the rate of 1,000ppm of elemental sulfur and incubated at room temperature



Acids used for irrigation water in California

Acid	Percent Acid	Formula	lb/gal	$
Phosphoric	53-54%	P_2O5	13.7-14	4
Sulfuric	93-98%	H_2SO_4	15.3	1
Urea Sulfuric Acid	27-55%	$((NH_2)_2\ CO)H_2SO_4$	11.8-12.8	1.50

Source: J. Gregroy, Verdegaal Bros.

Acids used for irrigation water in California

Acid	Use
Phosphoric acid	acidification, source of P, cost?
Sulfuric acid	acidification, handling?
Urea sulfuric acid	acidification, source of N

Source: J. Gregory, Verdegaal Bros.

Acidification of irrigation water

- *Lab report for titration to pH 5 or below (4-5) reported in oz per 1000 gallons of irrigation water and can calculate amount per hr – this will typically neutralize a high % of bicarbonates.*
- *Inject acid as special fertilizer – urea sulfuric acid or similar - sulfuric acid or other strong acids require special handling and special equipment – stainless steel parts and restrictions on types of seals, etc.*

  1 gal H_2SO_4 = 20.7 lb ammonium sulfate = 5 lb S
- *Typically acid forming fertilizers alone are not enough to counteract the effects of high bicarbonates in water.*

Managing Acids for Water Injection

- *Hydrochloric, sulfuric, and phosphoric acids are highly toxic materials irritating to the skin, eyes, nose, throat, lungs, and digestive tract.*

- *Buffered acid fertilizers such as urea sulfuric acid (N-phuric) will damage clothing but little caustic effect on skin.*

- *Always wear goggles and chemical resistant (rubber, neoprene, vinyl, etc.) gloves, apron and boots whenever handling these acids.*

- *Acid must be poured into water, never vice versa, and should be done in a well-ventilated area.*

- *If spilled, remove clothing and shower immediately. Wash eyes with large quantities of water. Drink large quantities of water if acid is ingested - do not induce vomiting.*

Acidification of irrigation water

- *Any type of injector used for fertilizers*
  - *also check materials are compatible with acids*
  - *calibrate carefully – short term extremes Ok*
  - *sprinklers VS foliar damage*

- *Dilute concentrated acid > nonmetal tank prior to injection*
  - *most metal fittings, tanks, other parts of the system damaged by even dilute acid,*
  - *flushing the system frequently sufficient to avoid damage.*

- *Over-application of acid.*
  - *determine the proper amount of acid to apply*
  - *monitor system to assure correct amount is applied.*

  - *CHECK pH OF WATER COMING OUT OF LINE*

Other Soil Preparation Requirements for Blueberries

- *Medium to heavy soils*
  - *raised beds*
  - *wood waste incorporation*
- *Mulched soil surface*

Soil Preparation and pH Management for Blueberries

Mark Gaskell
Farm Advisor

UC Cooperative Extension
Santa Maria