Strawberry plant nutrient sufficiency levels revised

Mark Bolda, Mark Gaskell, Julie Fallon, Misael Sanchez, Tom Bottoms and Tim Hartz

It has been more than 30 years since UC published strawberry leaf nutrient diagnostic guidelines (Publication 4098, 'Strawberry deficiency symptoms: a visual and plant analysis guide to fertilization', released in 1980). In the years since that publication, varieties, production practices and yield expectations have changed considerably. In 2010 we began a project, funded by the California Strawberry Commission, to reevaluate leaf and petiole nutrient sufficiency ranges for day-neutral strawberries. With the cooperation of many berry growers in the Watsonville-Salinas and Santa Maria areas we collected leaf and petiole samples from more than 50 'Albion' fields over the past two production seasons. In each field samples were collected 5 times over the production season, from early spring through September, to document the nutrient concentration trends from pre-fruiting to post-peak production. Leaf samples were analyzed for total concentration of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), zinc (Zn), manganese (Mn), iron (Fe) and copper (Cu). Petioles were analyzed for NO_3-N, PO_4-P and K concentration.

After the season cooperating growers provided yield information, which allowed us to categorize the fields as being 'high yield' or low yield'. We then applied a process called DRIS (Diagnosis and Recommendation Integrated System) to mathematically evaluate the difference in nutrient concentrations as well as nutrient ratios between high yield and low yield fields. This process allowed us to identify which of the high yield fields were ideally balanced nutritionally. From this group of nutritionally balanced, high yield fields we were able to calculate a DRIS sufficiency range for each nutrient at each growth stage.

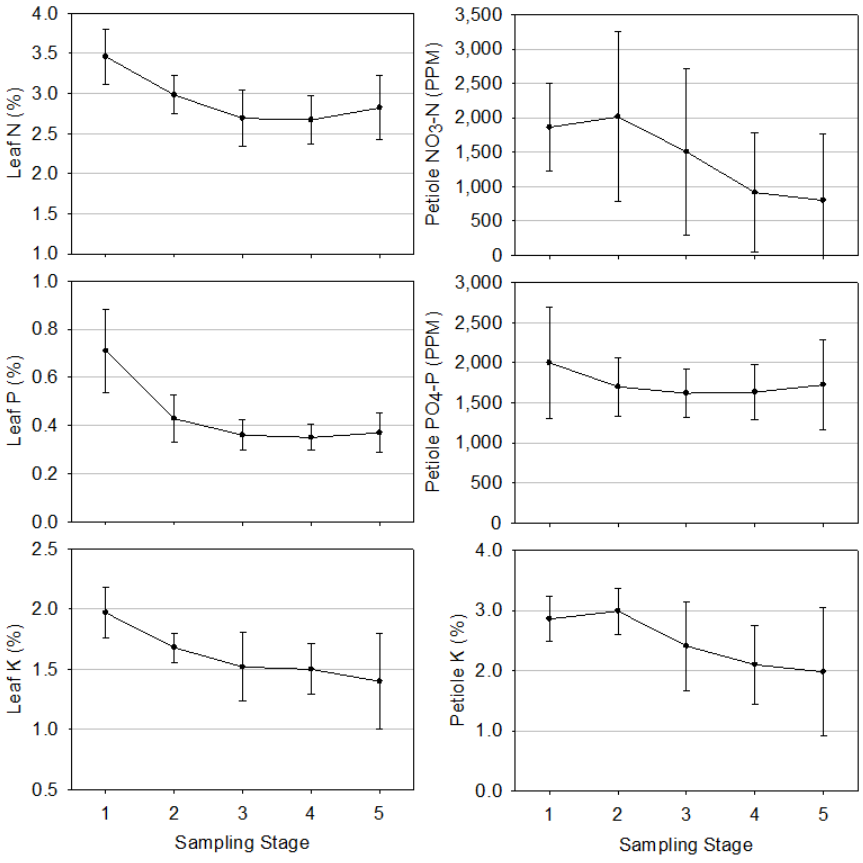

Fig. 1. Mean leaf and petiole macronutrient concentration across the production season; bars indicate the DRIS sufficiency ranges. For Santa Maria stage 1 = mid-February, stage 5 = mid-August.

Table 1. Comparison of DRIS leaf nutrient sufficiency ranges with prior UC recommendations, and current University of Florida guidelines.

		Nutrient sufficiency ranges		
Growth stage	Nutrient	DRIS	UC Pub. 4098	University of Florida
pre-harvest	% N	3.1 - 3.8		3.0 - 3.5
	% P	0.50 - 0.90		0.20 - 0.40
	% K	1.8 - 2.2		1.5 - 2.5
	% Ca	0.6 - 1.3		0.4 - 1.5
	% Mg	0.33 - 0.45		0.25 - 0.50
	% S	0.19 - 0.23		0.25 - 0.80
	PPM B	31 - 46		20 - 40
	PPM Zn	13 - 28		20 - 40
	PPM Mn	75 - 600		30 - 100
	PPM Fe	70 - 140		50 - 100
	PPM Cu	3.3 - 5.8		5 - 10
main harvest	% N	2.4 - 3.0	> 3.0	2.8 - 3.0
	% P	0.30 - 0.40	0.15 - 1.30	0.20 - 0.40
	% K	1.3 - 1.8	1.0 - 6.0	1.1 - 2.5
	% Ca	1.0 - 2.2	0.4 - 2.7	0.4 - 1.5
	% Mg	0.28 - 0.42	0.3 - 0.7	0.20 - 0.40
	% S	0.15 - 0.21	> 0.10	0.25 - 0.80
	PPM B	40 - 70	35 - 200	20 - 40
	PPM Zn	11 - 20	20 - 50	20 - 40
	PPM Mn	65 - 320	30 - 700	25 - 100
	PPM Fe	85 - 200	50 - 3,000	50 - 100
	PPM Cu	2.6 - 4.9	3 - 30	5 - 10

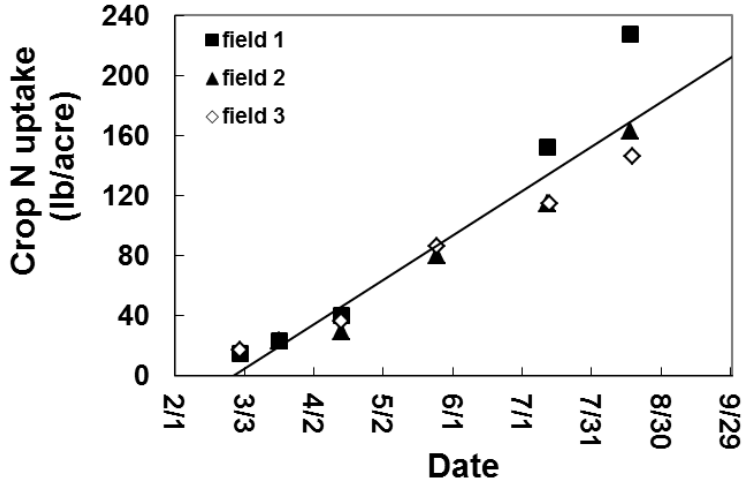

Fig. 2. Pattern of nitrogen uptake in Santa Maria 2011 strawberry fields.

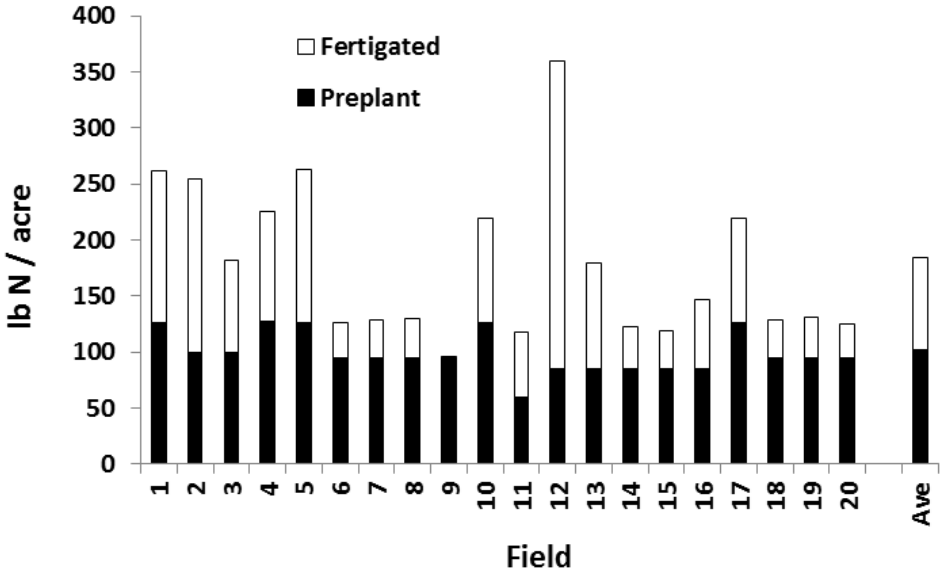

Fig. 3. Nitrogen management practices of Santa Maria growers, 2010 and 2011 fields.

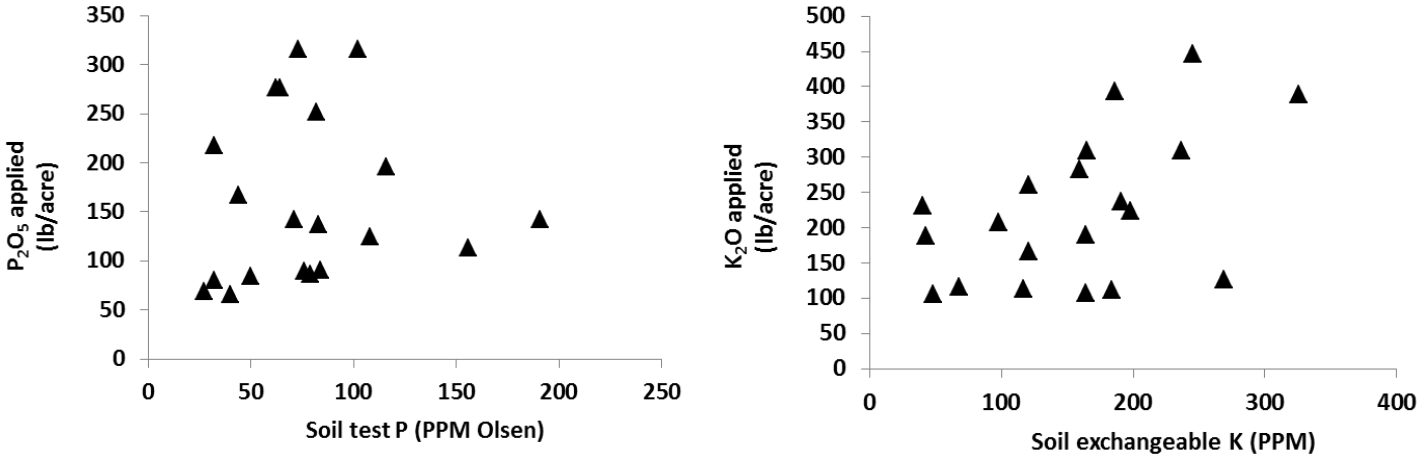

Fig. 4. Phosphorus and potassium management practices of Santa Maria growers, 2010 and 2011 fields.

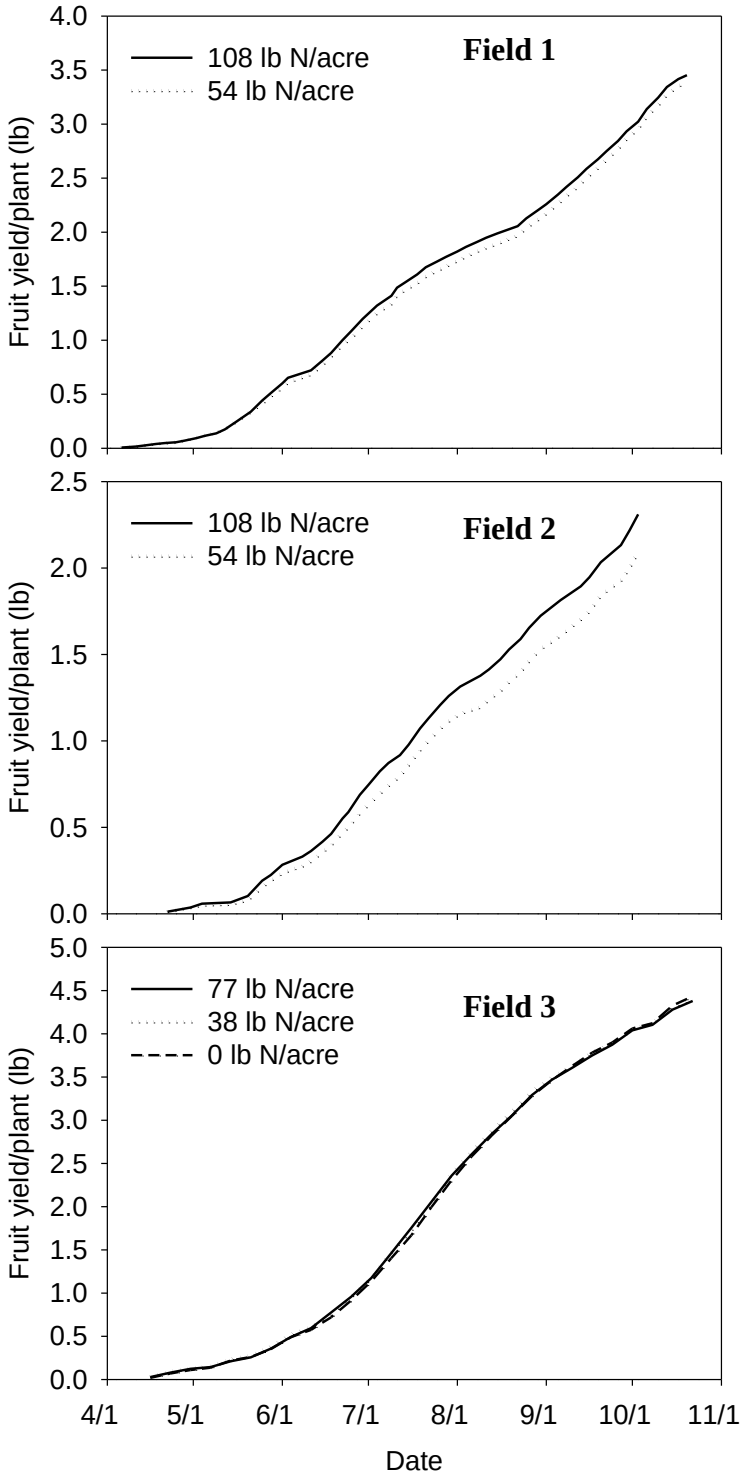

Fig. 5. Effects of preplant controlled release N on strawberry yield; trial fields in the Watsonville-Salinas area in 2011, highest rate in each field is the grower standard.