Plant Analyses

Leaf greenness readings can be used for real-time N management decisions. The N status of corn plants is reflected in the leaf color, with a light green color indicating low N availability, while a dark green color is typical for N-sufficient plants. The leaf greenness of corn plants can be determined using a hand-held device, such as the SPAD Chlorophyll Meter, or a canopy reflectance meter. Studies found that N fertilization is required to prevent yield loss when the relative leaf greenness drops below 90 to 96% of the well fertilized strip.

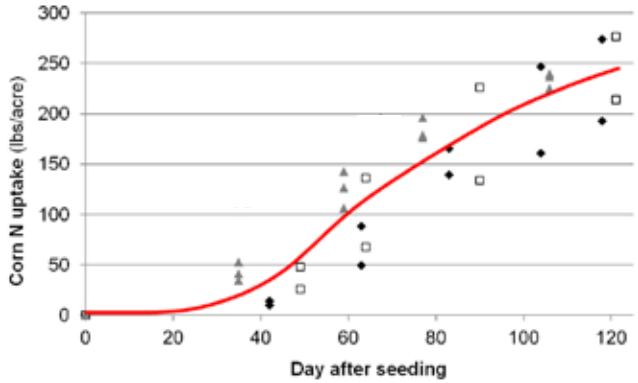
Plant Tissue Analysis Guidelines for Corn

		Sufficiency Range (%)		
Growth Stage	Sampled Plant Part	N	P	K
Early season (6-16")	Whole plant	3.5-5.0	0.4-0.6	3.0-5.0
Midgrowth (3-6 ft.)	First fully developed leaf; third from top	3.5-4.0	0.35-0.45	2.0-3.5
Tasseling	Leaf opposite and below primary ear	2.8-3.8	0.25-0.45	1.7-2.8
Silking	Leaf opposite and below primary ear	2.0-3.0	0.2-0.4	1.4-2.5

To review and evaluate the N fertilization program and to make adjustments for the following years, a stalk nitrate test at corn maturity can be performed. Optimal stalk nitrate-N concentrations range from 700 to 2000 ppm. Optimal values in fields where manure was fall applied are generally higher, possibly because a larger proportion of the manure N becomes available later in the season. Oregon State University Extension Service recommends an optimal range of 3,500 to 5,500 ppm nitrate-N.

Silage Corn Nitrogen Uptake and Partitioning

Seasonal N Uptake



Information regarding silage and grain corn fertility management, including placement, fertilizer source, phosphorus and potassium, is available at:

www.cdfa.ca.gov/go/FREPguide

SELECTED REFERENCES

Fernández, F.G., Nafziger, E.D., Ebelhar, S.A., Hoeft, R.G., 2012. Managing nitrogen. University of Illinois Extension & Outreach. Illinois Agronomy Handbook.

Davis, J.G., Westfall, D.G., 2009. Fertilizing corn. Colorado State University Extension. Fact Sheet No. 0.538.

Geisseler, D., Lazicki, P.A., Pettygrove G.S., Ludwig, B., Bachand, P.A.M., Horwath W.R., 2012. Nitrogen dynamics in irrigated forage systems fertilized with liquid dairy manure. Agronomy Journal 104, 897-907.

FERTILIZER RESEARCH AND EDUCATION PROGRAM
FREP

Silage and Grain

CORN

NITROGEN Fertilization Guidelines

Online nutrient guidelines for corn and other crops, as well as relevant references, are available at:

www.cdfa.ca.gov/go/FREPguide

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Daniel Geisseler and William R. Horwath, Department of Land, Air and Water Resources, UC Davis, gathered and organized the guideline information through FREP grant agreement 11-0485.

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UC DAVIS

Nitrogen Fertilization
PREPLANT and SOWING

Pre-plant N applications are only efficient when leaching during the early stages of corn growth is minimal. Pre-plant N fertilization rates should be adjusted by the residual soil nitrate-N in early spring.

Corn fertilization guidelines in a number of states recommend applying between 10 and 60 lbs N/acre with the starter. In a study carried out with silage corn in the Modesto area, the total N in the aboveground biomass was below 40 lbs/acre one month after planting. Therefore, with careful irrigation management, a starter application rate of 40 lbs/acre together with the residual soil nitrate provides enough N to the corn plants during the first month of growth.

Starter fertilizer is traditionally applied in a band 2 inches to the side and 2 inches below the seed to reduce the risk of salt damage. The N plus K2O applied should not exceed 70-80 lbs/acre.

The application of fertilizer in direct contact with the seeds (popup placement) may damage seedlings, especially in sandy soil and when the fertilizer has a high ammonium or K concentration. The maximum rate of N and K2O applied should not exceed 10-15 lbs/acre in medium and fine textured soils. Cooperative extension in some states even recommends limiting the amount of N and K2O applied to 8 lbs/acre. Seed placement is not recommended in sandy or dry soils.

Early studies have shown that P uptake and root growth can be increased by using starter fertilizers that contain P and N.

Nitrogen Fertilization
at 5-LEAF and 12-LEAF STAGES

Banding is generally the most efficient method of applying sidedress N because corn roots generally do not reach the middle of the rows until the corn plant has eight fully emerged leaves. Therefore, during approximately the first six weeks after planting, nutrients applied in a band close to the corn row are more likely to be available for plant uptake than nutrients broadcast over the entire soil surface. Sub-surface bands should be placed 8-15 inches away from the plants to reduce the amount of root pruning and injury from ammonia.

Sidedress broadcasting of granular fertilizer may cause leaf burn. Leaf injury and yield reduction have been found to be more pronounced with UAN and ammonium nitrate than with urea. Up to 90 lbs N/acre as UAN or urea may be applied at the 4- to 5-leaf stage or up to 60 lbs/acre at the 8-leaf stage without reducing yields.

In furrow irrigation systems, N should only be applied with the irrigation water when a tailwater recovery and reuse system is in place.

Range of recommended total N application rates (sidedress N plus starter N) based on expected yield and Pre-Sidedress Nitrate Test (PSNT) values from different states. *These values have not been tested in California.*

Grain Yield	(bu/ac)	150	175	200	225
	(t/ac)	4.2	4.9	5.6	6.3
Silage Yield	(t/ac)	25	29	33	38
		Total N to apply (lbs/A)			
PSNT ppm nitrate-N	<10	150-180	175-215	200-240	225-270
	10-15	110-150	130-170	150-190	175-220
	15-20	85-120	100-140	115-150	125-170
	20-25	35-55	50-75	60-90	75-120
	25-30	0	0	0-40	25-70

Nitrogen Fertilization
at SILKING/TASSELING and MATURITY

When losses are minimized, corn needs about 1-1.25 lbs N/bushel of grain, which corresponds to approximately 6-7.2 lbs. N/ ton of silage corn. Therefore, for a grain yield of 180 bu/acre (5 tons/acre) or a silage corn yield of 30 tons/acre, the plants require between 180 and 216 lbs. N/acre. This includes fertilizer N and soil derived N.

Nitrogen fertilization after silking is generally only beneficial when the plants are clearly deficient. Nitrogen fertilizer applications at milk stage may increase yield in extremely deficient plants, but may actually decrease yield when corn is only slightly deficient.

Foliar Applications

The amount of N that can be absorbed through the leaves is relatively small and studies generally did not find a yield effect due to foliar N applications. Foliar N applications after silking may increase protein yield but also the risk of lodging.

High N concentrations in the foliar solutions may damage the leaves. Urea generally causes less leaf damage than potassium nitrate, ammonium polyphosphate, ammonium sulfate or urea phosphate.

For more information and references about N management in corn, access the crop fertilization guidelines at:

www.cdfa.ca.gov/go/FREPguide