

DEFICIENCY SYMPTOMS IN CROPS

Chlorotic Symptoms

CROP	WHEAT	BARLEY	OATS	MAIZE	SORGHUM	SUNFLOWER	SOYBEAN	COTTON
Deficiency symptoms appear on young leaves whilst old leaves remain green and healthy	Ca, Cu, Fe & S	B, Ca, Cu, Fe, Mn & S	B, Ca, Cu & Zn	B, Ca, Cu & Zn	B, Cu, Fe, Mn & Zn	B, Ca, Fe, Mn & S	B, Fe, Mn & S	Fe & Mn
Deficiency symptoms appear on old leaves whilst young leaves remain green and healthy	N, P & K	Mg, N, P & K	Mg, K & Zn	Mg, P, & K	Mh	Ca, Mg & K	K & Zn	Cu, Mg, N & K
Chlorosis of young leaves (early stages)	Ca, Cu, Fe & Mn	B, Ca, Cu, Fe, Mn & S	B, Ca, Cu, Fe & S	B, Cu, Fe, S & Zn	B, Ca, Cu, Fe, Mn, S & Zn	B, Ca, Fe, Mn & S	B, Ca, Fe, Mn & S	Fe, Mn, S & Zn
Chlorosis of middle age leaves	Zn	An	Mn & Zn	Mn		Mg	Zn	
Chlorosis of old leaves (early stages)	Mg, N, P & K	Mg, N, P & K	Mg, N, P, K & Zn	Mg, N, P & K	Mg, N, P & K	Mg, N, P & K	Mg, N & K(s)	Cu, Mg, N, P & K
Interveinal chlorosis	Fe, Mg & Zn	B, Fe & Zn	Fe & Mg	B, Cu, Fe & Mg	B, Fe, Mg, Mn, K & Zn	Ca, Fe, Mg, Mn & P	B, Ca & Fe	Cu, Fe, Mg, Mn & K
Marginal chlorosis	K	K & P	B & P	Cu	Ca	K & N		P
Chlorosis starts from tip	N, P & K	N & K	B, Cu, N & P	Cu, N & P				
Veinal chlorosis					N			
Whole leaf chlorosis	S	S	S	P & S	S	N & S	S	N & S
Mottled interveinal chlorosis							Mg, Mn & Zn	K & Zn
Interveinal chlorosis (mid section of leaf)		K & Zn	Zn					
Basal chlorosis						Ca		
Veins green and prominent in early stages of chlorosis	Fe, Mg & K	Fe	Fe	Fe & Mn	Fe & Mg	Fe & Mg	Fe, Mg, Mn & Zn	Cu, Fe, Mg, Mn, N, P & S
Yellow – pale green chlorosis	Cu, Mg, Mn, N, P & Zn	Fe, N & Zn	B, Cu, Fe, Mg, N & S	B, Fe, Mg, Mn, N & K	Ca, Cu, Fe, Mg, N, P, K & Zn	B, Ca, Fe, Mn, N, P, K & S	B, Ca, Fe, Mn & S	Cu, Fe, Mg, Mn, N, P & S
Yellow – orange – brown chlorosis	K		Mg, P & K				P & K(s)	
Orange – purple chlorosis	P	P	Zn(s)					
Yellow mottling on older leaves						Mg		
Chlorosis followed by death			Cu, Mg(s) & P(s)	Cu, Mn, P & Zn	Ca & Zn	N		P

Tissue Symptoms

CROP	WHEAT	BARLEY	OATS	MAIZE	SORGHUM	SUNFLOWER	SOYBEAN	COTTON
Pale green or yellow foliage	Fe, Mn, S & Zn	Cu, Fe, Mg, Mn, N, K & S	Ba, Ca, Cu, Fe, Mn, N, K, S & Zn	B, Cu, Fe, Mn, N, K, S & Zn	Cu(s), Mg, N, P, K & S	Ca, Fe, Mn & S	Mg, Mn, N, K & S	Fe, Mg, N & S
Dark green leaves	Ca	Ca	P	P	P(s)		B, Ca & P(s)	B, Ca, Mn & P
Orange – red leaves	P		B & Fe					
Purple leaves or suffusion	P	P		P & S	P(s)			
Rust brown striped leaves				Mg				
Red leaf tips			N, P & Zn					
Purple leaf margins (old leaves)		S						
Blue – green foliage							P	
Rolled leaves			P					B & N
Brittle leaves	Ca	Ca & Mn	Ca		B & Ca	B & Ca		
Squared leaf ends due to death of leaf tip	Ca	Ca						
Young leaves short and erect					P			
Smaller or shorter leaves	Mn & P	N	Ca & P	B, Ca, N & P	B, Ca & N	Cu(s) & Mn	P	Cu, N, P & Zn
Erect leaves	Ca, N & P	N	Ca & P	B, Ca, N & P	B & Ca			
Wilted leaves or entire plant	Cu, Mn & K	Cu, Mn & K	Ca & Cu	Cu & Mn				Ca & Fe
Transparent areas between margin and mid vein on middle leaves					P			
Torn or malformed young leaves						K	Fe, Mg & K	Mn
Black straw	Cu							
Short stems		S	B, Ca, Mn, S & Zn	B, Ca, Mn, K, S & Zn	B, Ca, Cu(s), Mg, K & S	B, Ca, Mg, P, K & S	Ca, Mg, Mn & K	B, Cu, Fe(s), Mg, Mn, N, P, K, S & Zn
Thin Stems	K & Zn	Cu, Fe, Mn, N & S	N & S	Cu, Fe, Mn, N & K	Cu(s), Fe, Mg, Mn, N & S	Fe, Mg, Mn, N(s), P & S	Fe, Mg, Mn, N, P, K & S	Ca, Fe(s), Mg, N, P, K, S & Zn
Stout Stems	Ca, Cu, Mg, Mn & Zn	Ca, Mn, P & K	B & Mn	B, Ca, P, S & Zn	B, Ca, P(s) & K	B, Ca & K	B & Ca	B & Mn
Spindly Stems	Cu, Mg, Mn, N, K & Zn	Fe, Mg & N	N	Cu, Fe, N, P & K(s)	Cu(s), Fe, Mn, N & S	Fe, Mn, N(s) & S	Fe, Mg, N & P	
Pale Green Stems						N		
Red Stems		N & S		Fe, N & K(s)	N(s)			N & P
Purple Stems	P	P & S	P & S	Fe & P	P			

Growth Patterns and Development

CROP	WHEAT	BARLEY	OATS	MAIZE	SORGHUM	SUNFLOWER	SOYBEAN	COTTON
Stunted Growth	K & S	B, Ca, Cu, Fe, Mg, N, P & K	B, Ca, Fe, Mg, Mn, K, S, Zn & Cu	Cu, Fe, K & Zn	B, Ca, Cu, Fe, P(s) & K	B, Ca, Fe, Mg & K	B, Ca, Fe, N & S	Ca, Cu, Mg, Mn, S & Zn
Patches of poor growth within a healthy crop	Mn & Zn	Cu, Mn & Zn	Cu, Mn & Zn	Cu, Mn & Zn	Mn	Mn	Mn	Mn & Zn
Failure or difficulty of young leaves to emerge	Ca	K	Zn	B & Ca				
Failure of young leaves to unroll		B	Fe	Ca(s)				
Stems/internodes fail to elongate		B, Ca & Zn	B & Zn	Zn	B, Ca & Zn	B, Ca(s)	B	B, Ca & Zn
Fan shaped stems	Ca	B, Ca & Zn	B	Ca & Zn	B, Ca & Zn			
Reduced branching							B, Ca, Fe(s), Mn, N, P, K & S	Cu, Mg, Mn, N, P, K, S & Zn
Bushy (rosette) growth at top of plant		K & Zn	K & Zn	Ca		B	B	B, Ca & Zn
Leaves hang down and/or roll into a tube		K	Ca	Mg(s)		Ca	N, P & Zn	Cu & Fe
Bent petioles (resulting in leaves pointing downwards)						P(s)		
Leaf tips and/or margins curl up or down giving a wavy appearance				Mn		B & K	Fe, Mn, K & Zn	Cu, Fe, Mn, K, S & Zn
Delayed maturity	Cu & K	Cu			Cu, N, P & K	N & P	P, K & S	N & K
Leaf fall of younger leaves							Mn(s)	
Leaf drop							P	Mg
Bud leaves fail to expand				Zn		B		

Fruit, Flower or Grain Production

CROP	WHEAT	BARLEY	OATS	MAIZE	SORGHUM	SUNFLOWER	SOYBEAN	COTTON
Reduced tiller production	Fe, Mn & N	Fe(s), Mn, N, P & S	Fe(s), Mg, Mn, N, P & S					
Increased tiller production	Cu & S	Cu						
Fewer tillers mature to produce heads or die before producing heads	Ca, Fe, Mg, Mn, N, P, K & Zn(s)	B, Ca, Fe, Mg, Mn, N(s), K, S & Zn	B, Cu(s), Mg(s), Mn, N, P, K(s) & Zn(s)		Ca			
Impaired growth of pollen tube, lower pollen production or non viable pollen	Cu	Cu	Cu	B, Cu & Zn(s)			B	
Fewer or smaller mature heads which set few grains/seed	Mg, P, K, S & Zn(s)	B, Mg, P, K, S & Zn	Cu, Mg(s) & S	Cu & Fe	B, Ca, Cu(s), Fe(s), Mg(s), Mn(s), N, P(s), K & S(s)	B, Fe(s), N, P, K & S(s)		
Reduced pod set							Ca, Fe(s), Mg, Mn, N, P, K & S	
Fewer flower bolls								B, Ca, Cu, Mg, Mn, N, P, K, S & Zn
Impaired ear and/or tassel development		Cu		B, Ca, Cu, Fe, Mn(s), K & Zn				
Reduced size and number of ears				N, P, K, S & Zn				
Flower development impeded						Ca	B(s)	Mn, N, P, K, S & Zn
White heads (containing no grain)	Cu							
Deformed seed							K	
Reduced kernel size				Fe, N, P & K				
Lower lint and seed yields								Ca, Mg, N, P, K, S & Zn
Mottled grain	N							
Low grain protein content	N & S	N & S	N & S	N & S	N & S			
Lower grain yield	Ca, Fe, Mg, Mn, N & S	B, Ca, Fe(s), Mg, N, Mn, P, K, S & Zn	B, Cu, Fe, Mg, Mn, N, P, K, S & Zn	B, Ca, Fe, Mn(s), N, P, K, S & Zn	B, Ca, Fe(s), Mg(s), Mn(s), N, K & S(s)	B(s), Mg, Mn(s), N & P	B(s), Ca, Fe(s), Mg, Mn, N, P & S	Cu

Necrosis and Death

CROP	WHEAT	BARLEY	OATS	MAIZE	SORGHUM	SUNFLOWER	SOYBEAN	COTTON
Bronze pale brown necrotic lesions			B & Mn	Mg, N & K	Cu & N	Mn, Ca, Fe(s) & K	Fe, K & Mg	Mg, S & K
Dark brown necrotic lesions	Zn	B, Mg & K	Cu & Zn		B, Mg, P & Mn(s)	Mg, Ca & P	Ca, Zn, B, Fe, Mn, P & K	N, K, Mn & Zn
Grey dark brown necrotic lesions		Mn & Zn	K			P		
Grey or white crystalline flecks or necrotic lesions		Mn & K	Mn			B		P
White or yellow bands between midvein and margins				Zn				
White – yellow interveinal lesions on young leaves	Mn			Ca	B & Mn			
White – yellow interveinal lesions on older leaves				Mg				
Lesions on stems and petioles						B		
Necrosis on older leaves	Mg	Zn			N	K		N
Necrotic lesions on petioles/stems						Ca	Fe & K	Ca & K
Necrotic lesions on leaf sheaths	Zn(s)							
Necrosis concentrated around leaf tips & margins					K			
Veinal necrosis					N		Ca & Fe	
Marginal necrosis		B		Mn & K	Bu, Cu, P & K	Mg	Fe & K	K
Interveinal necrosis	Mg			Mg	Zn	Fe(s), Mn, P & K	B, Mg, Mn, P & Zn	Mg, N, P, K(s), S & Zn
Dead tissue rolls or twists into a tube, circle or spiral	Ca & Cu	Ca & Cu	Cu & N	Cu, N & K	Cu	N		
Death of florets (whiteheads)		Cu						
Death of shoots	Mn	B & Ca	Ca	Ca & Cu(s)	Mn(s)			
Death of leaf tips		B, Ca & Cu	Zn					
Death of youngest leaves before complete emergence from leaf sheath	Mn	Ca			Mn(s)			
Tissue margin death	K							
Death of middle leaf area	Zn		K					
Death of basal tissue	Mn					B		B
Death of whole leaf				Mn & N	Mn(s), N, P & K	N	N, K & Zn	Ca, Mg, N, P & Zn
Death of plant								
Bud death						B & Ca	B	Ca
Death before maturity	Mn		Ca			B		Ca(s)
Death of plant from top down	Cu	Cu	Cu					
Thatch of dead leaves around base of plant	N & P	Mg, N & K	N, P & K		N, P & K			B & Ca(s)