

Spectral indices (SIs) included in this study and their formulations

Type	Index	Short	Formulation	Reference
	Reciprocal Reflectance	RR	$1/R_{700}$	Gitelson et al. (1999)
	Modified Red-edge Ratio	MSR	$(R_{750}-R_{445})/(R_{705}-R_{445})$	Sims and Gamon (2002)
	Pigment Specific Simple Ratio	PSSRa	R_{800}/R_{675}	Blackburn (1998b)
		PSSRb	R_{800}/R_{650}	Blackburn (1999)
	Ratio Analysis of Reflectance Spectra	RARSa	R_{675}/R_{700}	Chappelle et al. (1992)
		RARSb	$R_{675}/(R_{675} \times R_{700})$	Chappelle et al. (1992)
	Red-edge NDVI	mNDVI	$(R_{750}-R_{705})/(R_{750}+R_{705})$	Gitelson and Merzlyak (1994)
				Sims and Gamon (2002)
	Modified Red-edge Normalized Difference Vegetation Index	mNDI	$(R_{750}-R_{705})/(R_{750}-R_{705}-2R_{445})$	Sims and Gamon (2002)
Chlorophyll	Green NDVI	gNDVI	$(R_{750}-R_{550})/(R_{750}+R_{550})$	Gitelson and Merzlyak (1996)
				Datt (1998)
	Pigment Specific Normalized Difference	PSNDA	$(R_{800}-R_{675})/(R_{800}+R_{675})$	Blackburn (1998a)
		PSNDb	$(R_{800}-R_{650})/(R_{800}+R_{650})$	
		PSNDc	$(R_{800}-R_{470})/(R_{800}+R_{470})$	
	Macc01	Macc01	$(R_{780}-R_{710})/(R_{780}-R_{680})$	Maccioni et al. (2001)
	The MERIS terrestrial chlorophyll ind	MTCI	$(R_{754}-R_{709})/(R_{709}-R_{681})$	Dash and Curran (2004)
	DATT	DATT	$(R_{850}-R_{710})/(R_{850}-R_{680})$	Datt (1999)
	Modified DATT	MDATT	$(R_{721}-R_{744})/(R_{721}-R_{714})$	Lu et al. (2018)
	Vogelmann indices	VOG1	R_{740}/R_{720}	
		VOG2	$(R_{734}-R_{747})/(R_{715}-R_{726})$	Vogelmann et al. (1993)
		VOG3	$(R_{734}-R_{747})/(R_{715}+R_{720})$	
	Gitelson & Merzlyak indices	GM1	R_{750}/R_{550}	Gitelson and Merzlyak (1996)
	Transformed Chlorophyll Absorption in Reflectance Index	GM2	R_{750}/R_{700}	
	Chlorophyll Index	TCARI	$3 \times [(R_{700}-R_{670}) - 0.2 \times (R_{700}-R_{550}) \times (R_{700}/R_{670})]$	Haboudane et al. (2002)
		CI	R_{750}/R_{710}	Haboudane et al.

	Red Edge			(2002)
	Simple Ratio Pigment Index	SRPI	R_{430}/R_{680}	Penuelas et al. (1995)
	Normalized Pigments Index	NPCI	$(R_{680}-R_{430})/(R_{680}+R_{430})$	Penuelas et al. (1995)
	Carter indices	CTRI1 CAR	R_{695}/R_{420} R_{695}/R_{760}	Carter (1994)
	Reflectance band ratio indices	DCabCxc NDIRCabCx c	$R_{672}/(R_{550}\times 3R_{708})$ $R_{860}/(R_{550}\times R_{708})$	Datt (1998)
	Structure-Intensive Pigment Index	SIPI	$(R_{800}-R_{445})/(R_{800}+R_{680})$	Penuelas et al. (1995)
	Chl _{RE} opt	ChlRE opt	$(1/R_{680-730}-1/R_{780-800})\times R_{755-780}$	Féret et al. (2011)
	RI _{708,775}	RI _{708,775}	R_{708}/R_{775}	Féret et al. (2011)
	ND _{780,712}	ND _{780,712}	$(R_{780}-R_{712})/(R_{780}+R_{712})$	Féret et al. (2011)
	Chlorophyll/carotenoid Index	CCI	$(R_{531}-R_{645})/(R_{531}+R_{645})$	Gamon et al. (2016)
	LAI insensitive chlorophyll index	LICI	$LICI=R_{735}/R_{720}-(R_{573}-R_{680})/(R_{573}+R_{680})$	Li et al. (2020)
	Ratio Analysis of Reflectance Spectra	RARSc	R_{760}/R_{500}	Chappelle et al. (1992)
	Pigment Specific Simple Ratio	PSSRc	R_{800}/R_{470}	Blackburn (1998a)
	Photochemical Reflectance Index	PRI	$(R_{531}-R_{570})/(R_{531}+R_{570})$	Gamon et al. (1992)
Carotenoid		CRI ₅₅₀	$(1/R_{510})-(1/R_{550})$	
		CRI ₇₀₀	$(1/R_{510})-(1/R_{700})$	
	Carotenoid Reflectance Index	CRI _{515,550}	$(1/R_{515})-(1/R_{550})$	
		CRI _{515,700}	$(1/R_{515})-(1/R_{700})$	
		PNIR×CRI ₇₀ ₀	$(1/R_{510})-(1/R_{550})\times R_{770}$	Gitelson et al. (2002)
		PNIR×CRI ₇₇ ₀	$(1/R_{510})-(1/R_{700})\times R_{770}$	
	<i>Car</i> _{RE} opt	<i>Car</i> _{RE} opt	$(1/R_{510-530}-1/R_{680-730})\times R_{760-780}$	
	RI _{530,800}	RI _{530,800}	R_{530}/R_{800}	Féret et al. (2011)
	ND _{800,530}	ND _{800,530}	$(R_{800}-R_{530})/(R_{800}+R_{530})$	
Anthocyanin	Anthocyanin Reflectance Index	ARI	$R_{550}^{-1} - R_{700}^{-1}$	Gitelson et al. (2001)
	Modified Anthocyanin Reflectance Index	mARI	$(R_{530-570}^{-1} - R_{690-710}^{-1}) \times R_{NIR}$	Gitelson et al. (2006)
Xanthophyll	Photochemical Refl. Index (515)	PRI ₅₁₅	$(R_{515}-R_{531})/(R_{515}+R_{531})$	Hernandez-Clemente et al. (2011)

Photochemical Refl. Index (512)	PRI ₅₁₂	$(R_{512}-R_{531})/(R_{512}+R_{531})$	Hernandez- Clemente et al. (2011)	
Photochemical Refl. Index (600)	PRI ₆₀₀	$(R_{600}-R_{531})/(R_{600}+R_{531})$	Gamon et al. (1992)	
Photochemical Refl. Index (670)	PRI ₆₇₀	$(R_{670}-R_{531})/(R_{670}+R_{531})$	Gamon et al. (1992)	
Photochemical Refl. Index (670 and 570)	PRI _{670, 570}	$(R_{570}-R_{531}-R_{670})/\\(R_{570}+R_{531}+R_{670})$	Hernandez- Clemente et al. (2011)	
Carotenoid/Chlorophyll Ratio Index	PRI \times CI	$(R_{570}-R_{530})/(R_{570}+R_{530}) \\ \times((R_{760}/R_{700})-1)$	Garrity et al. (2011)	
Redness Index	R	R_{700}/R_{670}	Gitelson et al. (2000)	
Greenness Index	G	R_{570}/R_{670}	Calderón et al. (2013)	
Blue Index	B	R_{450}/R_{490}	Calderón et al. (2013)	
Blue/green index	BGI1	R_{400}/R_{550}	Zarco-Tejada et al. (2005)	
Blue/green index	BGI2	R_{450}/R_{550}	Zarco-Tejada et al. (2005)	
Blue/red index	BRI1	R_{400}/R_{690}	Zarco-Tejada et al. (2012)	
Blue/red index	BRI2	R_{450}/R_{690}	Zarco-Tejada et al. (2012)	
R/G/B color	BF1	R_{400}/R_{410}	Zarco-Tejada et al. (2018)	
	BF2	R_{400}/R_{420}	Zarco-Tejada et al. (2018)	
	BF3	R_{400}/R_{430}	Zarco-Tejada et al. (2018)	
	BF4	R_{400}/R_{440}	Zarco-Tejada et al. (2018)	
	BF5	R_{400}/R_{450}	Zarco-Tejada et al. (2018)	
Red/green index	RGI	R_{690}/R_{550}	Zarco-Tejada et al. (2005)	
Ratio Analysis of Reflectance Spectra	RARS	R_{746}/R_{513}	Chappelle et al. (1992)	
Lichtenthaler Index	LIC1	$(R_{800}-R_{680})/(R_{800}+R_{680})$	Lichtenthaler et al. (1996)	
	LIC2	R_{440}/R_{690}		
	LIC3	R_{440}/R_{740}		
Nitrogen	Optimal vegetation	$V_{I_{opt}}$	$(1+0.45)\times(R_{800}^2+1)/(R_{670}+0.4)$	Reyniers et al.

	index		5)	(2006)
Normalized difference vegetation index green-blue	NDVI _{g-b}	$(R_{573}-R_{440})/(R_{573}+R_{440})$		Hansen & Schjoerring. (2003)
Ratio vegetation index I	RVI I	R_{810}/R_{660}		Zhu et al. (2008)
Ratio vegetation index II	RVI II	R_{810}/R_{560}		Xue et al. (2004)
Nitrogen reflectance index	NRI	$(R_{570}-R_{670})/(R_{570}+R_{670})$		Bausch & Duke. (1996)
Combined index	MCARI	$MCARI=[R_{700}-R_{670}-0.2(R_{700}-R_{550})]\times(R_{700}/R_{670})$		Eitel et al. (2007)
Double-peak canopy nitrogen index	DCNI	$(R_{720}-R_{700})/(R_{700}-R_{670})/(R_{720}-R_{670}+0.03)$		Chen et al. (2010)
Angular insensitivity vegetation index	AIVI	$AIVI=[R_{445}\times(R_{720}+R_{735})-R_{573}\times(R_{720}-R_{735})]/[R_{720}\times(R_{573}+R_{445})]$		He et al. (2016)
Health-index	HI_2013	$(R_{534}-R_{698})/(R_{534}+R_{698})-0.5\times R_{704}$		Mahlein et al. (2013)
Powdery mildew-index	PMI_2013	$(R_{520}-R_{584})/(R_{520}+R_{584})+R_{724}$		Mahlein et al. (2013)
Cercospora leaf spot-index	CLSI_2013	$(R_{698}-R_{570})/(R_{698}+R_{570})-R_{734}$		Mahlein et al. (2013)
Sugar beet rust-index	SBRI_2013	$(R_{570}-R_{513})/(R_{570}+R_{513})+0.5R_{704}$		Mahlein et al. (2013)
Health-index	HI_2014	$(R_{739}-R_{402})/(R_{739}+R_{402})-0.5R_{403}$		Huang et al. (2014)
Powdery mildew-index	PMI_2014	$(R_{515}-R_{698})/(R_{515}+R_{698})-0.5R_{738}$		Huang et al. (2014)
Yellow rust-index	YRI_2014	$(R_{730}-R_{419})/(R_{730}+R_{419})+0.5R_{736}$		Huang et al. (2014)
Aphids_index	AI_2014	$(R_{400}-R_{735})/(R_{400}+R_{735})+0.5R_{403}$		Huang et al. (2014)
Plant Senescence Reflectance Index	PSRI	$(R_{680}-R_{500})/R_{750}$		Merzlyak et al. (1999)
Normalized Phaeo Phytnization Index	NPQI	$(R_{415}-R_{435})/(R_{415}+R_{435})$		Penuelas et al. (1995)
Reflectance Curvature Index	CUR	$(R_{675}\times R_{690})/R_{683}^2$		Zarco-Tejada et al. (2000)
Ratio Powdery Mildew Index	RPMI	$RPMI=R_{744}/R_{762}-0.5R_{710}$		He et al. (2020)
Damage sensitive spectral index 1	DSSI1	$DSSI1=(R_{719}-R_{873}-R_{509}-R_{537})/(R_{719}-R_{873}+R_{509}-R_{537})$		Mirik et al. (2006)
Damage sensitive	DSSI2	$DSSI2=(R_{747}-R_{901}-R_{537})$		

	spectral index 2		$R_{572})/(R_{747}-R_{901}+R_{537}-R_{572})$	
Nir shoulder region index		NSRI	NSRI= R_{890}/R_{780}	Liu et al. (2014)
Water	Water index	WI	R_{900}/R_{970}	Penuelas et al. (1997)

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