

A Parameter-efficient Convolutional Approach for Camouflaged Weed Detection in Multispectral Aerial Imagery

Supplementary Material

Table 1. Ablation of the FCB α parameter for feature refinement, full results.

Alpha	Dataset	Modality	Precision \uparrow	Recall \uparrow	F1-score \uparrow	IoU _{BG} \uparrow	IoU _W \uparrow	mIoU \uparrow	Inference time (s)	Training time (h)	Total params. (M)	Trainable params. (M)	GFLOPS
0.00	WeedBananaCOD	RGB	0.870	0.832	0.851	0.991	0.738	0.865	0.0227	0.103	91.277	2.685	15.156
		RGB-NIR	0.871	0.846	0.858	0.991	0.751	0.871	0.0239	0.107	91.279	2.685	15.190
	WeedMap	RGB	0.687	0.699	0.693	0.985	0.530	0.758	0.0134	0.132	91.277	2.685	10.657
RGB-NIR		0.663	0.734	0.697	0.985	0.535	0.760	0.0140	0.138	91.279	2.685	10.680	
RGB-NIR-RE		0.706	0.698	0.702	0.986	0.531	0.759	0.0145	0.144	91.281	2.685	10.704	
0.01	WeedBananaCOD	RGB	0.875	0.815	0.844	0.990	0.730	0.860	0.0236	0.101	91.277	2.685	15.156
		RGB-NIR	0.876	0.843	0.860	0.991	0.754	0.873	0.0237	0.106	91.279	2.685	15.190
	WeedMap	RGB	0.676	0.713	0.694	0.985	0.531	0.758	0.0141	0.129	91.277	2.685	10.657
RGB-NIR		0.710	0.681	0.695	0.986	0.531	0.759	0.0144	0.137	91.279	2.685	10.680	
RGB-NIR-RE		0.708	0.693	0.700	0.986	0.536	0.761	0.0147	0.144	91.281	2.685	10.704	
0.02	WeedBananaCOD	RGB	0.845	0.848	0.846	0.990	0.734	0.862	0.0256	0.101	91.277	2.685	15.156
		RGB-NIR	0.856	0.839	0.847	0.990	0.735	0.863	0.0261	0.106	91.279	2.685	15.190
	WeedMap	RGB	0.668	0.723	0.694	0.985	0.532	0.758	0.0157	0.131	91.277	2.685	10.657
RGB-NIR		0.708	0.678	0.693	0.986	0.530	0.758	0.0189	0.136	91.279	2.685	10.680	
RGB-NIR-RE		0.698	0.696	0.697	0.986	0.535	0.761	0.0195	0.146	91.281	2.685	10.704	
0.03	WeedBananaCOD	RGB	0.866	0.826	0.846	0.990	0.732	0.861	0.0253	0.103	91.277	2.685	15.156
		RGB-NIR	0.868	0.842	0.855	0.991	0.747	0.869	0.0279	0.108	91.279	2.685	15.190
	WeedMap	RGB	0.666	0.720	0.692	0.983	0.529	0.756	0.0173	0.132	91.277	2.685	10.657
RGB-NIR		0.695	0.700	0.697	0.986	0.531	0.759	0.0175	0.140	91.279	2.685	10.680	
RGB-NIR-RE		0.709	0.686	0.697	0.986	0.535	0.761	0.0179	0.146	91.281	2.685	10.704	
0.04	WeedBananaCOD	RGB	0.875	0.821	0.847	0.991	0.734	0.863	0.0223	0.102	91.277	2.685	15.156
		RGB-NIR	0.873	0.855	0.864	0.991	0.761	0.876	0.0283	0.108	91.279	2.685	15.190
	WeedMap	RGB	0.688	0.693	0.690	0.985	0.527	0.756	0.0125	0.130	91.277	2.685	10.657
RGB-NIR		0.694	0.692	0.693	0.986	0.530	0.758	0.0132	0.138	91.279	2.685	10.680	
RGB-NIR-RE		0.663	0.730	0.695	0.987	0.532	0.760	0.0135	0.144	91.281	2.685	10.704	
0.05	WeedBananaCOD	RGB	0.862	0.816	0.838	0.990	0.722	0.856	0.0254	0.102	91.277	2.685	15.156
		RGB-NIR	0.887	0.841	0.863	0.992	0.760	0.876	0.0281	0.109	91.279	2.685	15.190
	WeedMap	RGB	0.678	0.702	0.690	0.985	0.527	0.756	0.0158	0.130	91.277	2.685	10.657
RGB-NIR		0.690	0.696	0.693	0.985	0.530	0.758	0.0164	0.138	91.279	2.685	10.680	
RGB-NIR-RE		0.663	0.730	0.695	0.985	0.532	0.759	0.0169	0.145	91.281	2.685	10.704	
0.06	WeedBananaCOD	RGB	0.869	0.819	0.843	0.990	0.729	0.860	0.0279	0.101	91.277	2.685	15.156
		RGB-NIR	0.876	0.847	0.861	0.991	0.756	0.874	0.0245	0.109	91.279	2.685	15.190
	WeedMap	RGB	0.663	0.734	0.697	0.985	0.535	0.760	0.0125	0.132	91.277	2.685	10.657
RGB-NIR		0.687	0.699	0.693	0.985	0.530	0.758	0.0138	0.140	91.279	2.685	10.680	
RGB-NIR-RE		0.706	0.700	0.703	0.986	0.542	0.764	0.0141	0.146	91.281	2.685	10.704	
0.07	WeedBananaCOD	RGB	0.879	0.815	0.846	0.991	0.733	0.862	0.0227	0.099	91.277	2.685	15.156
		RGB-NIR	0.865	0.865	0.865	0.991	0.762	0.877	0.0298	0.105	91.279	2.685	15.190
	WeedMap	RGB	0.680	0.711	0.695	0.985	0.534	0.760	0.0141	0.128	91.277	2.685	10.657
RGB-NIR		0.686	0.706	0.696	0.986	0.545	0.766	0.0145	0.134	91.279	2.685	10.680	
RGB-NIR-RE		0.672	0.727	0.698	0.987	0.547	0.767	0.0147	0.142	91.281	2.685	10.704	
0.08	WeedBananaCOD	RGB	0.883	0.839	0.861	0.991	0.755	0.873	0.0222	0.104	91.277	2.685	15.156
		RGB-NIR	0.867	0.810	0.837	0.990	0.720	0.855	0.0223	0.104	91.279	2.685	15.190
	WeedMap	RGB	0.644	0.746	0.691	0.984	0.528	0.756	0.0102	0.132	91.277	2.685	10.657
RGB-NIR		0.698	0.691	0.694	0.986	0.532	0.759	0.0122	0.139	91.279	2.685	10.680	
RGB-NIR-RE		0.702	0.693	0.697	0.986	0.535	0.761	0.0166	0.147	91.281	2.685	10.704	
0.09	WeedBananaCOD	RGB	0.864	0.803	0.832	0.990	0.713	0.851	0.0215	0.104	91.277	2.685	15.156
		RGB-NIR	0.872	0.842	0.857	0.991	0.749	0.870	0.0240	0.105	91.279	2.685	15.190
	WeedMap	RGB	0.701	0.690	0.695	0.984	0.532	0.758	0.0169	0.130	91.277	2.685	10.657
RGB-NIR		0.684	0.702	0.693	0.985	0.531	0.758	0.0177	0.143	91.279	2.685	10.680	
RGB-NIR-RE		0.713	0.679	0.696	0.986	0.537	0.762	0.0172	0.144	91.281	2.685	10.704	
0.10	WeedBananaCOD	RGB	0.865	0.805	0.834	0.990	0.715	0.853	0.0243	0.102	91.277	2.685	15.156
		RGB-NIR	0.869	0.846	0.857	0.991	0.750	0.870	0.0253	0.107	91.279	2.685	15.190
	WeedMap	RGB	0.673	0.717	0.694	0.981	0.529	0.755	0.0171	0.132	91.277	2.685	10.657
RGB-NIR		0.701	0.691	0.696	0.986	0.532	0.759	0.0185	0.138	91.279	2.685	10.680	
RGB-NIR-RE		0.710	0.692	0.701	0.984	0.540	0.762	0.0192	0.147	91.281	2.685	10.704	

Table 2. Ablation of the of the FCB bottleneck ratio, full results.

Refine depth	Dataset	Modality	Precision \uparrow	Recall \uparrow	F1-score \uparrow	IoU _{BG} \uparrow	IoU _W \uparrow	mIoU \uparrow	Inference time (s)	Training time (h)	Total params. (M)	Trainable params. (M)	GFLOPS
1	WeedBananaCOD	RGB	0.873	0.831	0.852	0.991	0.739	0.865	0.0248	0.107	92.682	4.090	16.260
		RGB-NIR	0.880	0.838	0.859	0.991	0.752	0.872	0.0306	0.112	92.684	4.090	16.293
		RGB-NIR-RE	0.874	0.835	0.855	0.991	0.745	0.869	0.0276	0.109	92.684	4.090	16.293
	WeedMap	RGB	0.668	0.696	0.682	0.985	0.517	0.751	0.0167	0.135	92.682	4.090	11.432
		RGB-NIR	0.644	0.730	0.684	0.984	0.520	0.752	0.0169	0.139	92.684	4.090	11.456
		RGB-NIR-RE	0.674	0.725	0.699	0.985	0.537	0.761	0.0171	0.148	92.686	4.090	11.480
2	WeedBananaCOD	RGB	0.879	0.815	0.846	0.991	0.733	0.862	0.0227	0.099	91.277	2.685	15.156
		RGB-NIR	0.865	0.865	0.865	0.991	0.762	0.877	0.0298	0.105	91.279	2.685	15.190
		RGB-NIR-RE	0.874	0.835	0.855	0.991	0.745	0.869	0.0276	0.109	91.279	2.685	15.190
	WeedMap	RGB	0.680	0.711	0.695	0.985	0.534	0.760	0.0141	0.128	91.277	2.685	10.657
		RGB-NIR	0.686	0.706	0.696	0.986	0.545	0.766	0.0145	0.134	91.279	2.685	10.680
		RGB-NIR-RE	0.672	0.727	0.698	0.987	0.547	0.767	0.0147	0.142	91.281	2.685	10.704
3	WeedBananaCOD	RGB	0.813	0.833	0.829	0.988	0.728	0.858	0.0220	0.096	90.812	2.221	14.882
		RGB-NIR	0.875	0.822	0.848	0.990	0.753	0.872	0.0276	0.102	90.814	2.221	14.915
		RGB-NIR-RE	0.874	0.835	0.855	0.991	0.745	0.869	0.0276	0.109	90.814	2.221	14.915
	WeedMap	RGB	0.694	0.684	0.689	0.985	0.526	0.756	0.0137	0.121	90.812	2.221	10.464
		RGB-NIR	0.674	0.722	0.697	0.985	0.538	0.762	0.0138	0.126	90.814	2.221	10.487
		RGB-NIR-RE	0.709	0.698	0.703	0.986	0.543	0.764	0.0140	0.129	90.816	2.221	10.511
4	WeedBananaCOD	RGB	0.873	0.815	0.843	0.990	0.729	0.859	0.0214	0.094	90.583	1.991	14.747
		RGB-NIR	0.860	0.841	0.851	0.991	0.740	0.865	0.0258	0.097	90.585	1.991	14.780
		RGB-NIR-RE	0.874	0.835	0.855	0.991	0.745	0.869	0.0258	0.097	90.585	1.991	14.780
	WeedMap	RGB	0.696	0.660	0.678	0.985	0.513	0.749	0.0127	0.118	90.583	1.991	10.369
		RGB-NIR	0.670	0.711	0.690	0.985	0.527	0.756	0.0127	0.123	90.585	1.991	10.393
		RGB-NIR-RE	0.661	0.728	0.693	0.985	0.530	0.758	0.0129	0.124	90.587	1.991	10.416
5	WeedBananaCOD	RGB	0.838	0.794	0.815	0.989	0.688	0.838	0.0214	0.090	90.449	1.857	14.692
		RGB-NIR	0.833	0.818	0.825	0.989	0.702	0.846	0.0248	0.095	90.451	1.857	14.725
		RGB-NIR-RE	0.833	0.818	0.825	0.989	0.702	0.846	0.0248	0.095	90.451	1.857	14.725
	WeedMap	RGB	0.693	0.670	0.681	0.985	0.517	0.751	0.0125	0.114	90.449	1.857	10.330
		RGB-NIR	0.672	0.706	0.689	0.985	0.525	0.755	0.0123	0.125	90.451	1.857	10.354
		RGB-NIR-RE	0.695	0.691	0.693	0.986	0.530	0.758	0.0128	0.124	90.453	1.857	10.377

Table 3. Ablation of the depthwise kernel size in the FCB block, full results.

Refine depth	Dataset	Modality	Precision \uparrow	Recall \uparrow	F1-score \uparrow	IoU _{BG} \uparrow	IoU _W \uparrow	mIoU \uparrow	Inference time (s)	Training time (h)	Total params. (M)	Trainable params. (M)	GFLOPS
1	WeedBananaCOD	RGB	0.846	0.797	0.821	0.989	0.696	0.842	0.0225	0.096	91.269	2.677	15.141
		RGB-NIR	0.849	0.769	0.807	0.988	0.677	0.833	0.0296	0.103	91.271	2.677	15.174
		RGB-NIR-RE	0.849	0.769	0.807	0.988	0.677	0.833	0.0296	0.103	91.271	2.677	15.174
	WeedMap	RGB	0.702	0.692	0.697	0.986	0.535	0.760	0.0130	0.123	91.269	2.677	10.646
		RGB-NIR	0.735	0.660	0.695	0.985	0.533	0.759	0.0137	0.135	91.271	2.677	10.669
		RGB-NIR-RE	0.701	0.694	0.697	0.986	0.537	0.761	0.0139	0.140	91.273	2.677	10.693
3	WeedBananaCOD	RGB	0.879	0.815	0.846	0.991	0.733	0.862	0.0227	0.099	91.277	2.685	15.156
		RGB-NIR	0.865	0.865	0.865	0.991	0.762	0.877	0.0298	0.105	91.279	2.685	15.190
		RGB-NIR-RE	0.874	0.835	0.855	0.991	0.745	0.869	0.0276	0.109	91.279	2.685	15.190
	WeedMap	RGB	0.680	0.711	0.695	0.985	0.534	0.760	0.0141	0.128	91.277	2.685	10.657
		RGB-NIR	0.686	0.706	0.696	0.986	0.545	0.766	0.0145	0.134	91.279	2.685	10.680
		RGB-NIR-RE	0.672	0.727	0.698	0.987	0.547	0.767	0.0147	0.142	91.281	2.685	10.704
5	WeedBananaCOD	RGB	0.861	0.815	0.838	0.990	0.724	0.857	0.0248	0.103	91.292	2.700	15.188
		RGB-NIR	0.876	0.860	0.868	0.990	0.753	0.872	0.0300	0.107	91.294	2.700	15.221
		RGB-NIR-RE	0.876	0.860	0.868	0.990	0.753	0.872	0.0300	0.107	91.294	2.700	15.221
	WeedMap	RGB	0.693	0.700	0.696	0.986	0.532	0.759	0.0168	0.132	91.292	2.700	10.679
		RGB-NIR	0.707	0.661	0.684	0.986	0.540	0.763	0.0169	0.141	91.294	2.700	10.703
		RGB-NIR-RE	0.734	0.670	0.701	0.986	0.543	0.765	0.0173	0.147	91.269	2.700	10.726
7	WeedBananaCOD	RGB	0.813	0.809	0.811	0.988	0.682	0.835	0.0253	0.105	91.315	2.724	15.235
		RGB-NIR	0.866	0.830	0.848	0.991	0.736	0.863	0.0309	0.109	91.317	2.724	15.269
		RGB-NIR-RE	0.866	0.830	0.848	0.991	0.736	0.863	0.0309	0.109	91.317	2.724	15.269
	WeedMap	RGB	0.697	0.686	0.691	0.985	0.527	0.756	0.0176	0.132	91.315	2.724	10.712
		RGB-NIR	0.705	0.689	0.697	0.986	0.535	0.761	0.0178	0.144	91.317	2.724	10.736
		RGB-NIR-RE	0.731	0.663	0.695	0.986	0.533	0.760	0.0174	0.147	91.319	2.724	10.759

Table 4. Ablation study of the FPN feature dimension, full results.

Refine depth	Dataset	Modality	Precision \uparrow	Recall \uparrow	F1-score \uparrow	IoU _{BG} \uparrow	IoU _W \uparrow	mIoU \uparrow	Inference time (s)	Training time (h)	Total params. (M)	Trainable params. (M)	GFLOPS
96	WeedBananaCOD	RGB	0.855	0.816	0.835	0.990	0.717	0.853	0.0222	0.093	90.763	2.172	10.448
		RGB-NIR	0.879	0.823	0.850	0.991	0.739	0.865	0.0292	0.095	90.765	2.172	10.482
	WeedMap	RGB	0.734	0.647	0.688	0.986	0.524	0.755	0.0130	0.126	90.763	2.172	7.346
		RGB-NIR	0.714	0.673	0.693	0.986	0.530	0.758	0.0132	0.133	90.765	2.172	7.370
		RGB-NIR-RE	0.699	0.699	0.699	0.984	0.537	0.761	0.0135	0.142	90.767	2.172	7.393
	128	WeedBananaCOD	RGB	0.879	0.815	0.846	0.991	0.733	0.862	0.0227	0.099	91.277	2.685
RGB-NIR			0.865	0.865	0.865	0.991	0.762	0.877	0.0298	0.105	91.279	2.685	15.190
WeedMap		RGB	0.680	0.711	0.695	0.985	0.534	0.760	0.0141	0.128	91.277	2.685	10.657
		RGB-NIR	0.686	0.706	0.696	0.986	0.545	0.766	0.0145	0.134	91.279	2.685	10.680
		RGB-NIR-RE	0.672	0.727	0.698	0.987	0.547	0.767	0.0147	0.142	91.281	2.685	10.704
160		WeedBananaCOD	RGB	0.856	0.805	0.830	0.989	0.719	0.854	0.0252	0.105	91.919	3.328
	RGB-NIR		0.859	0.844	0.841	0.990	0.748	0.869	0.0308	0.108	91.921	3.328	21.205
	WeedMap	RGB	0.721	0.661	0.690	0.986	0.526	0.756	0.0170	0.132	91.919	3.328	14.886
		RGB-NIR	0.670	0.725	0.696	0.983	0.535	0.759	0.0171	0.143	91.920	3.328	14.910
		RGB-NIR-RE	0.713	0.688	0.701	0.986	0.541	0.764	0.0177	0.151	91.923	3.328	14.934
	192	WeedBananaCOD	RGB	0.854	0.835	0.844	0.990	0.731	0.861	0.0260	0.107	92.691	4.099
RGB-NIR			0.871	0.847	0.859	0.991	0.750	0.871	0.0316	0.110	92.693	4.099	28.528
WeedMap		RGB	0.718	0.664	0.690	0.983	0.527	0.755	0.0170	0.131	92.691	4.099	20.035
		RGB-NIR	0.691	0.701	0.696	0.986	0.542	0.764	0.0173	0.147	92.693	4.099	20.059
		RGB-NIR-RE	0.695	0.704	0.699	0.985	0.545	0.765	0.0179	0.153	92.695	4.099	20.082

Table 5. Ablation of the decoder refinement depth, full results.

Refine depth	Dataset	Modality	Precision \uparrow	Recall \uparrow	F1-score \uparrow	IoU _{BG} \uparrow	IoU _W \uparrow	mIoU \uparrow	Inference time (s)	Training time (h)	Total params. (M)	Trainable params. (M)	GFLOPS
0	WeedBananaCOD	RGB	0.867	0.804	0.834	0.990	0.716	0.853	0.0219	0.093	90.981	2.390	10.312
		RGB-NIR	0.860	0.829	0.844	0.990	0.731	0.860	0.0226	0.094	90.983	2.390	10.346
	WeedMap	RGB	0.713	0.640	0.674	0.985	0.509	0.747	0.0140	0.131	90.981	2.390	7.251
		RGB-NIR	0.706	0.665	0.685	0.986	0.521	0.753	0.0144	0.135	90.983	2.390	7.274
		RGB-NIR-RE	0.715	0.671	0.692	0.986	0.530	0.758	0.0146	0.135	90.985	2.390	7.298
	1	WeedBananaCOD	RGB	0.853	0.814	0.833	0.990	0.713	0.852	0.0219	0.095	91.129	2.537
RGB-NIR			0.868	0.835	0.851	0.991	0.741	0.866	0.0229	0.097	91.131	2.537	12.768
WeedMap		RGB	0.653	0.717	0.684	0.984	0.520	0.752	0.0145	0.133	91.129	2.537	8.954
		RGB-NIR	0.692	0.688	0.690	0.985	0.527	0.756	0.0146	0.133	91.131	2.537	8.977
		RGB-NIR-RE	0.691	0.710	0.700	0.986	0.539	0.762	0.0147	0.139	91.133	2.537	9.001
2		WeedBananaCOD	RGB	0.879	0.815	0.846	0.991	0.733	0.862	0.0227	0.099	91.277	2.685
	RGB-NIR		0.865	0.865	0.865	0.991	0.762	0.877	0.0298	0.105	91.279	2.685	15.190
	WeedMap	RGB	0.680	0.711	0.695	0.985	0.534	0.760	0.0141	0.128	91.277	2.685	10.657
		RGB-NIR	0.686	0.706	0.696	0.986	0.545	0.766	0.0145	0.134	91.279	2.685	10.680
		RGB-NIR-RE	0.672	0.727	0.698	0.987	0.547	0.767	0.0147	0.142	91.281	2.685	10.704
	3	WeedBananaCOD	RGB	0.853	0.828	0.840	0.990	0.725	0.857	0.0251	0.105	91.424	2.833
RGB-NIR			0.876	0.843	0.859	0.991	0.753	0.872	0.0278	0.107	91.426	2.833	17.612
WeedMap		RGB	0.647	0.696	0.670	0.984	0.504	0.744	0.0150	0.131	91.424	2.833	12.360
		RGB-NIR	0.697	0.705	0.701	0.986	0.540	0.763	0.0154	0.141	91.426	2.833	12.383
		RGB-NIR-RE	0.682	0.726	0.704	0.986	0.543	0.764	0.0157	0.145	91.428	2.833	12.407
4		WeedBananaCOD	RGB	0.858	0.783	0.819	0.989	0.693	0.841	0.0249	0.106	91.572	2.981
	RGB-NIR		0.847	0.851	0.849	0.990	0.737	0.864	0.0263	0.107	91.574	2.981	20.034
	WeedMap	RGB	0.660	0.708	0.683	0.985	0.519	0.752	0.0153	0.138	91.572	2.981	14.063
		RGB-NIR	0.707	0.687	0.697	0.986	0.531	0.759	0.0153	0.142	91.574	2.981	14.087
		RGB-NIR-RE	0.726	0.663	0.693	0.987	0.536	0.762	0.0161	0.147	91.576	2.981	14.110
	5	WeedBananaCOD	RGB	0.853	0.814	0.833	0.990	0.714	0.852	0.0268	0.108	91.720	3.128
RGB-NIR			0.855	0.819	0.837	0.990	0.719	0.855	0.0276	0.110	91.722	3.128	22.457
WeedMap		RGB	0.698	0.683	0.691	0.986	0.527	0.756	0.0161	0.140	91.720	3.128	15.766
		RGB-NIR	0.694	0.696	0.695	0.986	0.532	0.759	0.0165	0.149	91.722	3.128	15.790
		RGB-NIR-RE	0.683	0.713	0.697	0.985	0.535	0.760	0.0167	0.146	91.724	3.128	15.813

Table 6. Comparison of the proposed FCB with other alternatives, full results.

Refine depth	Dataset	Modality	Precision \uparrow	Recall \uparrow	F1-score \uparrow	IoU _{BG} \uparrow	IoU _W \uparrow	mIoU \uparrow	Inference time (s)	Training time (h)	Total params. (M)	Trainable params. (M)	GFLOPS
w/o FCB	WeedBananaCOD	RGB	0.834	0.765	0.798	0.988	0.664	0.826	0.0223	0.093	89.871	1.280	14.053
		RGB-NIR	0.835	0.802	0.818	0.989	0.693	0.841	0.0250	0.094	89.874	1.280	14.087
	WeedMap	RGB	0.736	0.627	0.677	0.978	0.514	0.746	0.0131	0.121	89.871	1.280	9.881
		RGB-NIR	0.760	0.612	0.678	0.981	0.519	0.750	0.0134	0.125	89.874	1.280	9.905
		RGB-NIR-RE	0.728	0.650	0.687	0.982	0.521	0.752	0.0134	0.130	89.876	1.280	9.928
	w/CBAM	WeedBananaCOD	RGB	0.843	0.819	0.831	0.989	0.710	0.850	0.0382	0.140	90.048	1.457
RGB-NIR			0.847	0.792	0.819	0.988	0.693	0.840	0.0421	0.144	90.050	1.457	14.089
WeedMap		RGB	0.717	0.659	0.687	0.978	0.521	0.750	0.0282	0.188	90.048	1.457	9.883
		RGB-NIR	0.717	0.651	0.682	0.983	0.518	0.751	0.0286	0.194	90.050	1.457	9.906
		RGB-NIR-RE	0.749	0.643	0.692	0.985	0.523	0.754	0.0292	0.202	90.052	1.457	9.930
w/FCB		WeedBananaCOD	RGB	0.879	0.815	0.846	0.991	0.733	0.862	0.0227	0.099	91.277	2.685
	RGB-NIR		0.865	0.865	0.865	0.991	0.762	0.877	0.0298	0.105	91.279	2.685	15.190
	WeedMap	RGB	0.680	0.711	0.695	0.985	0.534	0.760	0.0141	0.128	91.277	2.685	10.657
		RGB-NIR	0.686	0.706	0.696	0.986	0.545	0.766	0.0145	0.134	91.279	2.685	10.680
		RGB-NIR-RE	0.672	0.727	0.698	0.987	0.547	0.767	0.0147	0.142	91.281	2.685	10.704

Table 7. Performance comparison of FCBNet across different ConvNeXt encoders, full results.

Encoder	Dataset	Modality	Precision \uparrow	Recall \uparrow	F1-score \uparrow	IoU _{BG} \uparrow	IoU _W \uparrow	mIoU \uparrow	Inference time (s)	Training time (h)	Total params. (M)	Trainable params. (M)	GFLOPS
ConvNeXt-tiny	WeedBananaCOD	RGB	0.866	0.807	0.835	0.990	0.717	0.853	0.0139	0.060	30.604	2.015	13.151
		RGB-NIR	0.872	0.830	0.851	0.991	0.740	0.865	0.0149	0.062	30.605	2.015	13.176
	WeedMap	RGB	0.742	0.663	0.701	0.985	0.537	0.761	0.0095	0.083	30.604	2.015	9.247
		RGB-NIR	0.734	0.679	0.705	0.986	0.540	0.763	0.0103	0.091	30.605	2.015	9.264
		RGB-NIR-RE	0.719	0.704	0.711	0.986	0.543	0.764	0.0107	0.098	30.607	2.015	9.282
	ConvNeXt-small	WeedBananaCOD	RGB	0.822	0.767	0.793	0.987	0.658	0.822	0.0178	0.075	52.238	2.015
RGB-NIR			0.837	0.815	0.826	0.989	0.703	0.846	0.0200	0.080	52.240	2.015	13.565
WeedMap		RGB	0.748	0.660	0.701	0.985	0.540	0.762	0.0132	0.107	52.238	2.015	9.520
		RGB-NIR	0.721	0.689	0.704	0.986	0.544	0.765	0.0144	0.113	52.240	2.015	9.538
		RGB-NIR-RE	0.753	0.670	0.709	0.987	0.545	0.766	0.0133	0.118	52.241	2.015	9.556
ConvNeXt-base		WeedBananaCOD	RGB	0.879	0.815	0.846	0.991	0.733	0.862	0.0227	0.099	91.277	2.685
	RGB-NIR		0.865	0.865	0.865	0.991	0.762	0.877	0.0298	0.105	91.279	2.685	15.190
	WeedMap	RGB	0.680	0.711	0.695	0.985	0.534	0.760	0.0141	0.128	91.277	2.685	10.657
		RGB-NIR	0.686	0.706	0.696	0.986	0.545	0.766	0.0145	0.134	91.279	2.685	10.680
		RGB-NIR-RE	0.672	0.727	0.698	0.987	0.547	0.767	0.0147	0.142	91.281	2.685	10.704
	ConvNeXt-large	WeedBananaCOD	RGB	0.880	0.830	0.854	0.991	0.746	0.868	0.0360	0.169	202.322	4.555
RGB-NIR			0.870	0.872	0.871	0.992	0.771	0.881	0.0381	0.171	202.325	4.555	19.554
WeedMap		RGB	0.735	0.679	0.706	0.987	0.546	0.766	0.0252	0.201	202.322	4.555	13.714
		RGB-NIR	0.693	0.723	0.708	0.986	0.548	0.767	0.0251	0.211	202.325	4.555	13.749
		RGB-NIR-RE	0.739	0.680	0.709	0.987	0.551	0.769	0.0257	0.215	202.329	4.555	13.784

Table 8. FCBNet compared to other approaches from the literature, full results. We have selected the best and lightest FCBNet model for comparison.

Encoder	Dataset	Modality	Precision \uparrow	Recall \uparrow	F1-score \uparrow	IoU $_{BG}$ \uparrow	IoU $_{W}$ \uparrow	mIoU \uparrow	Inference time (s)	Training time (h)	Total params. (M)	Trainable params. (M)	GFLOPS
FCBNet-tiny	WeedBananaCOD	RGB	0.866	0.807	0.835	0.990	0.717	0.853	0.0139	0.060	30.604	2.015	13.151
		RGB-NIR	0.872	0.830	0.851	0.991	0.740	0.865	0.0149	0.062	30.605	2.015	13.176
	WeedMap	RGB	0.742	0.663	0.701	0.985	0.537	0.761	0.0095	0.083	30.604	2.015	9.247
		RGB-NIR	0.734	0.679	0.705	0.986	0.540	0.763	0.0103	0.091	30.605	2.015	9.264
		RGB-NIR-RE	0.719	0.704	0.711	0.986	0.543	0.764	0.0107	0.098	30.607	2.015	9.282
	FCBNet-large	WeedBananaCOD	RGB	0.880	0.830	0.854	0.991	0.746	0.868	0.0360	0.169	202.322	4.555
RGB-NIR			0.870	0.872	0.871	0.992	0.771	0.881	0.0381	0.171	202.325	4.555	19.554
WeedMap		RGB	0.735	0.679	0.706	0.987	0.546	0.766	0.0252	0.201	202.322	4.555	13.714
		RGB-NIR	0.693	0.723	0.708	0.986	0.548	0.767	0.0251	0.211	202.325	4.555	13.749
		RGB-NIR-RE	0.739	0.680	0.709	0.987	0.551	0.769	0.0257	0.215	202.329	4.555	13.784
WeedSense		WeedBananaCOD	RGB	0.745	0.749	0.747	0.984	0.596	0.790	0.0223	0.089	12.721	12.721
	RGB-NIR		0.808	0.734	0.769	0.986	0.625	0.805	0.0225	0.093	12.723	12.723	12.778
	WeedMap	RGB	0.535	0.799	0.641	0.979	0.471	0.725	0.0115	0.138	12.721	12.721	8.952
		RGB-NIR	0.644	0.720	0.680	0.984	0.515	0.749	0.0190	0.151	12.723	12.723	8.985
		RGB-NIR-RE	0.653	0.716	0.683	0.984	0.519	0.752	0.0196	0.166	12.724	12.724	9.018
	DeepLabV3+	WeedBananaCOD	RGB	0.877	0.811	0.843	0.988	0.721	0.855	0.0270	0.123	26.678	26.678
RGB-NIR			0.863	0.815	0.838	0.991	0.725	0.858	0.0390	0.125	26.681	26.681	36.968
WeedMap		RGB	0.618	0.744	0.675	0.983	0.509	0.746	0.0190	0.161	26.678	26.678	25.849
		RGB-NIR	0.633	0.734	0.680	0.984	0.515	0.749	0.0190	0.170	26.681	26.681	25.993
		RGB-NIR-RE	0.717	0.677	0.696	0.986	0.534	0.760	0.0200	0.189	26.684	26.684	26.137
U-Net		WeedBananaCOD	RGB	0.844	0.824	0.834	0.990	0.715	0.851	0.0243	0.097	32.521	32.521
	RGB-NIR		0.861	0.816	0.838	0.890	0.720	0.855	0.0257	0.100	32.524	32.524	42.976
	WeedMap	RGB	0.476	0.805	0.598	0.975	0.427	0.701	0.0109	0.119	32.521	32.521	30.073
		RGB-NIR	0.577	0.810	0.674	0.981	0.508	0.745	0.0112	0.126	32.524	32.524	30.218
		RGB-NIR-RE	0.677	0.745	0.710	0.986	0.550	0.768	0.0117	0.131	32.528	32.528	30.362
	SegFormer	WeedBananaCOD	RGB	0.842	0.799	0.820	0.989	0.695	0.842	0.0203	0.310	84.595	84.595
RGB-NIR			0.861	0.842	0.851	0.990	0.738	0.864	0.0295	0.312	84.598	84.598	49.784
WeedMap		RGB	0.779	0.591	0.672	0.986	0.506	0.746	0.0177	0.420	84.595	84.595	34.116
		RGB-NIR	0.660	0.733	0.694	0.985	0.532	0.758	0.0180	0.421	84.598	84.598	34.153
		RGB-NIR-RE	0.673	0.723	0.697	0.985	0.535	0.760	0.0189	0.421	84.601	84.601	34.189
SK-U-Net		WeedBananaCOD	RGB	0.790	0.772	0.781	0.986	0.641	0.813	0.0231	0.170	34.444	34.444
	RGB-NIR		0.877	0.782	0.827	0.990	0.705	0.847	0.0238	0.170	34.447	34.447	44.950
	WeedMap	RGB	0.615	0.797	0.694	0.983	0.532	0.758	0.0140	0.160	34.444	34.444	31.461
		RGB-NIR	0.652	0.757	0.701	0.982	0.539	0.761	0.0164	0.170	34.447	34.447	31.606
		RGB-NIR-RE	0.703	0.710	0.706	0.984	0.539	0.762	0.0140	0.178	34.450	34.450	31.751

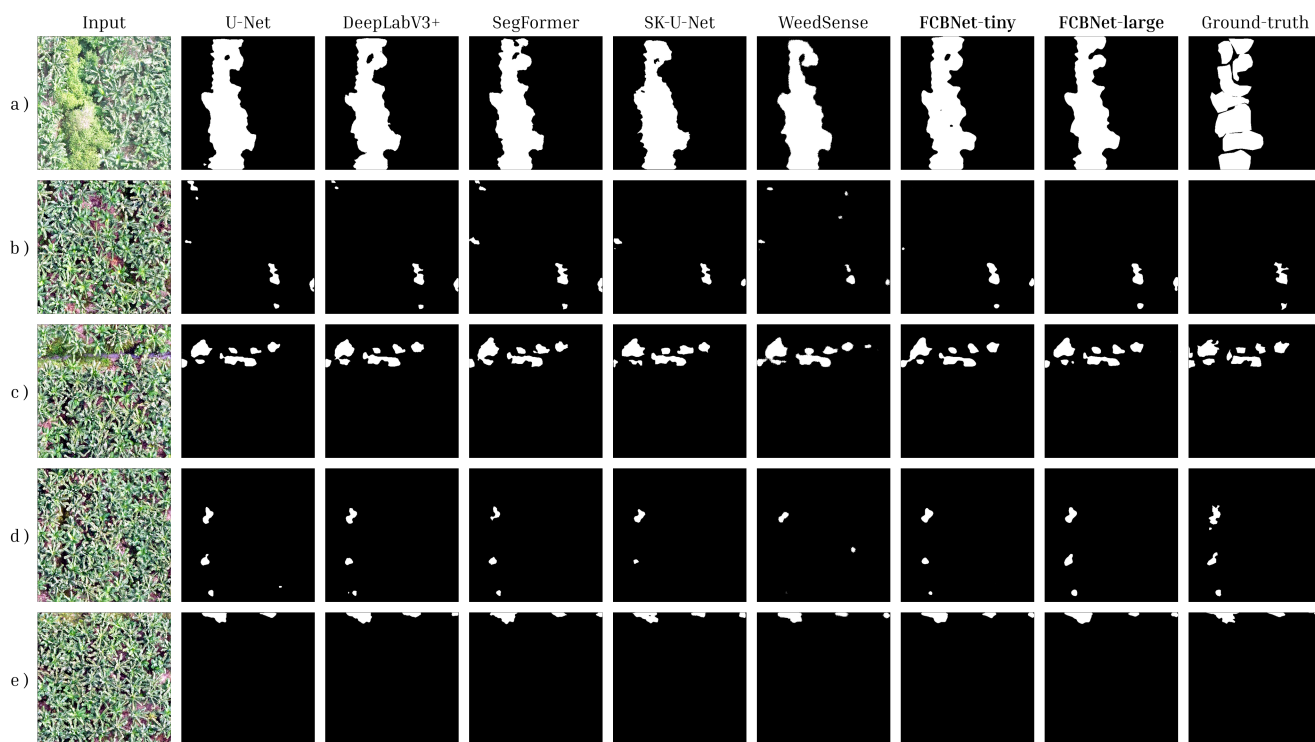


Figure 1. Qualitative comparison between FCBNet and other models from the state-of-the-art on the WeedBananaCOD dataset (RGB-NIR).

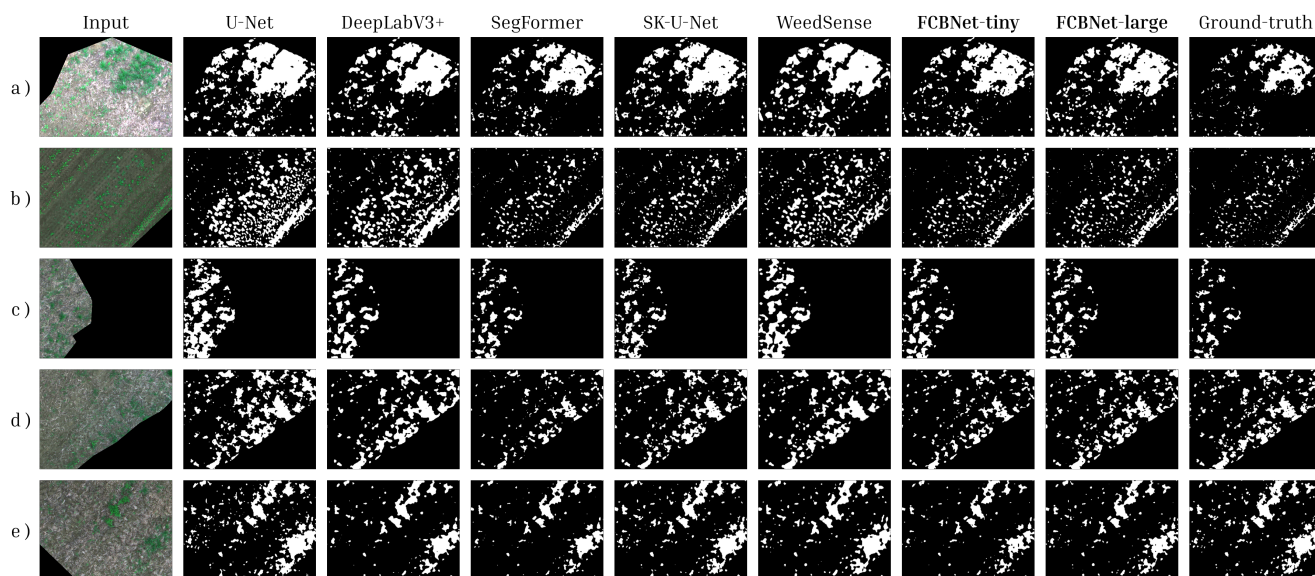


Figure 2. Qualitative comparison between FCBNet and other models from the state-of-the-art on the WeedMap dataset (RGB-NIR-RE).