

**Supplementary Table S2.** The evaluation results of the classification model of VIs.

			NM	PC	PCS	PN	S
PLS-DA	Precision	P.M.P	0.723	0.8	0.839	0.702	0.811
		Thres: 0.5	0.786	0.667	0.841	0.742	0.701
	Recall	P.M.P	0.312	0.61	0.563	0.277	0.647
		Thres: 0.5	0.135	0.007	0.122	0.06	0.073
	Accuracy	P.M.P	0.596	0.729	0.728	0.58	0.748
		Thres: 0.5	0.549	0.502	0.549	0.52	0.521
	FPR	P.M.P	0.119	0.153	0.108	0.118	0.15
		Thres: 0.5	0.037	0.003	0.023	0.021	0.031
	F1 score	P.M.P	0.436	0.692	0.674	0.397	0.72
		Thres: 0.5	0.23	0.013	0.213	0.111	0.133
XGBoost	Precision	P.M.P	0.921	0.941	0.919	0.909	0.932
		Thres: 0.5	0.932	0.948	0.93	0.924	0.941
	Recall	P.M.P	0.712	0.772	0.762	0.732	0.793
		Thres: 0.5	0.653	0.752	0.728	0.677	0.768
	Accuracy	P.M.P	0.825	0.862	0.847	0.829	0.868
		Thres: 0.5	0.803	0.855	0.837	0.81	0.86
	FPR	P.M.P	0.061	0.048	0.067	0.073	0.058
		Thres: 0.5	0.048	0.041	0.055	0.056	0.048
	F1 score	P.M.P	0.803	0.848	0.833	0.811	0.857
		Thres: 0.5	0.768	0.839	0.817	0.781	0.846

NM: non-mulching, PCs: crushed pinecones, PCS: a mixture of crushed pinecones and sulfur, PNs: pine needles, and S: sulfur treatment.