

Supplemental Table 2. Result of E2.1 to E2.3

Dataset	Trait	RMSE			r			R-squre			MAPE		
		E2.1	E2.2	E2.3	E2.1	E2.2	E2.3	E2.1	E2.2	E2.3	E2.1	E2.2	E2.3
Soybean	Beginning of blooming date (day)	9.881694761	11.47032085	9.452227688	0.821868941	0.812714694	0.837986507	0.668547646	0.55922167	0.698367323	12.8919252	13.98055325	11.30153917
Cotton	fiber elongation rate	0.683213506	0.732720119	0.672730184	0.696442685	0.644384058	0.70666889	0.47690858	0.398596156	0.493191533	5.361410839	5.870997994	2.583384737
Cotton	Fiber length (mm)	1.009453705	1.080794084	0.963051516	0.786221984	0.777739718	0.807518009	0.613123251	0.56032764	0.648696582	2.658899186	2.851463231	1.552458126
Cotton	Fiber micronaire	0.271362354	0.253054908	0.242897739	0.599399431	0.681576793	0.70012396	0.353298563	0.439348909	0.482807405	4.60703821	4.249043767	1.021729736
Cotton	Fiber strength (cN tex ⁻¹)	1.177743957	1.127838304	1.041701001	0.747918347	0.798141182	0.812297518	0.554373517	0.59938543	0.655074299	3.189098629	3.099121744	1.785741188
Wheat	Stripe rust disease severity (%)	26.97057053	28.96168943	26.54565525	0.473234075	0.282550617	0.480855407	0.211923166	0.072884784	0.220111204			
Soybean	C16 fatty acid content (µg/mg)	2.68629591	2.774525338	2.608191657	0.621748993	0.609542149	0.641531437	0.372738164	0.335746744	0.410680914	9.197154142	9.487512324	6.719677635
Soybean	C18 fatty acid content (µg/mg)	1.046019135	0.927995902	0.8534706	0.630727051	0.781129784	0.781355901	0.386841725	0.521354886	0.592797299	13.94196194	11.91551367	6.206138693
Soybean	Total fatty acid content (µg/mg)	19.3594069	19.18429569	18.51459589	0.616705759	0.659330079	0.658511854	0.371876764	0.384880139	0.425384395	8.047226402	7.922437114	7.337376252
Soybean	100-seed weight (g)	3.026063967	3.157989804	2.894763303	0.695111853	0.713615597	0.737704103	0.474724015	0.431381747	0.520076148	16.02003601	15.49648055	11.38732955
Soybean	Leaf length (cm)	1.049084404	1.062178675	1.029338068	0.455965212	0.434638911	0.477002687	0.196507126	0.176057975	0.224007149	9.237879348	9.148156385	4.748976603
Soybean	Leaf width (cm)	0.938177585	1.037270057	0.938177586	0.628926266	0.533954888	0.628926269	0.396440684	0.26639275	0.396440688	12.44053781	13.79485535	12.44053721
Maize	Interval between anthesis and tasseling (day)	0.718521215	0.73760259	0.68856324	0.580866325	0.58269584	0.615433322	0.319823069	0.283870127	0.37556395	18.21039923	18.50187474	7.604461536
Maize	cob weight (g)	3.608760482	3.526426667	3.368683672	0.496484683	0.540701088	0.579050815	0.231977017	0.262832935	0.330179474	14.49654278	14.32266281	10.56086794
Maize	Days to anthesis (day)	1.77788154	1.793752297	1.689498961	0.584990068	0.608091419	0.640938353	0.33614231	0.327007465	0.401361438	1.971582051	1.981845749	1.274126703
Maize	Days to silking (day)	1.995876266	1.992271411	1.89051466	0.533041087	0.556582553	0.595911649	0.269864761	0.276424292	0.344834816	2.111766104	2.132009135	1.400328781
Maize	Days to tasseling (day)	2.13854659	2.086335904	2.010276413	0.582693425	0.630093709	0.650234221	0.332304652	0.367233796	0.410404275	2.485720564	2.4209367	1.680551637
Maize	Ear diameter (cm)	0.221022467	0.213774598	0.209084335	0.462990948	0.539214483	0.543855386	0.203392847	0.254272234	0.284477971	4.167095374	4.025574232	0.781420702
Maize	Ear height (cm)	10.42624927	10.06628855	9.635678196	0.597290074	0.6396513	0.663026357	0.343936058	0.387168886	0.438704707	10.17569748	9.780207987	8.580412194
Maize	Ear length (cm)	1.186153106	1.177629831	1.134402215	0.527102698	0.555263001	0.585859635	0.274181111	0.283879334	0.335334202	6.926263786	6.844916248	3.801410496
Maize	Ear leaf length (cm)	4.874946359	4.73361051	4.50526011	0.598139509	0.654117635	0.665122793	0.346273409	0.382393679	0.44076205	4.941718932	4.782836583	3.885017075
Maize	Ear leaf width (cm)	0.651654741	0.665107282	0.621497774	0.622006493	0.614525443	0.659849055	0.380008679	0.354471168	0.434379846	5.557686987	5.624095376	2.373352684
Maize	Ear row number	1.140203998	1.157292491	1.090308881	0.619916887	0.626659096	0.655755947	0.369306192	0.34870161	0.422295391	6.140574894	6.184986476	3.418354895
Maize	Ear weight (g)	14.24738624	14.21249227	13.80796318	0.425157376	0.402422737	0.48580171	0.166041339	0.170629051	0.215928287	13.06555421	12.95355084	11.49846986
Maize	Kernel number per ear	49.51644643	49.33584704	47.49799347	0.432187887	0.433466889	0.494073225	0.169113612	0.173626785	0.233509985	13.48139338	13.33593264	12.3252809
Maize	Kernel number per row	2.634089485	2.681060866	2.528247213	0.502259214	0.454528222	0.552041349	0.237626496	0.206749807	0.294474575	10.27712646	10.60264082	7.258316912
Maize	Kernel weight per ear (g)	9.777230389	10.14522584	9.520439243	0.433392699	0.353248757	0.475105021	0.174045058	0.108095425	0.214106553	11.54107344	12.00528415	9.979758412
Maize	Length of barren tip (cm)	0.381811978	0.389638553	0.371416661	0.463238427	0.396951835	0.50659501	0.210263413	0.173513967	0.250420439	28.84783411	30.28101317	7.278428748
Maize	Leaf number above ear	0.426311738	0.431271639	0.401680067	0.593201825	0.61041617	0.65203182	0.3460904	0.333287289	0.421190319	5.223994463	5.338073894	1.696906462
Maize	Leaf number below ear	0.575982825	0.573373783	0.53754465	0.596313851	0.620431839	0.659189908	0.347016546	0.353383691	0.431991393	5.92160565	5.875153939	2.263191957
Maize	Plant height (cm)	16.24787782	15.47267853	14.88551559	0.582513741	0.647546627	0.662468648	0.334541538	0.396744077	0.439523124	6.177539358	5.910120099	5.317788497
Maize	Interval between silking and anthesis (day)	1.16927172	1.137696544	1.109948319	0.443952599	0.523856981	0.530322717	0.189342108	0.231529227	0.269453414			
Maize	Interval between silking and tasseling (day)	1.419516222	1.445868749	1.358384264	0.600685921	0.604775932	0.638419331	0.348488871	0.324976597	0.402714511	20.19271236	20.60564509	11.30057074
Maize	Tassel branch number	2.664288521	2.577441823	2.444057918	0.622298929	0.685102227	0.694045641	0.379985611	0.422340953	0.478096909	17.96927237	17.18833631	12.10852027
Maize	Tassel length (cm)	3.029368975	2.988953706	2.807477689	0.676159481	0.710531481	0.72783581	0.448522269	0.469084678	0.528337489	7.174009041	7.018819526	5.25149893
Soybean	Pod maturity date (day)	15.85591403	16.56963569	15.45547838	0.68219316	0.682005533	0.702095959	0.460592747	0.41179206	0.486985724	9.683826444	10.4904677	9.039041474
Millet	Fringe neck length (cm)	5.481296268	5.440205557	5.278867579	0.527947524	0.556920138	0.575411042	0.266690315	0.283723017	0.325217514	11.4901127	11.5836519	9.418196604
Millet	Hundred kernel weight (g)	0.297409233	0.302355969	0.296120806	0.371456208	0.388590296	0.438785306	0.099714469	-0.114882498	0.178985517	14.31890414	15.45212784	4.010230824
Millet	Main stem height (cm)	13.60596284	13.65305009	13.37238073	0.330329735	0.319440398	0.376519206	0.095485609	0.090047033	0.126025625	10.43978197	10.69740058	9.54004541
Millet	Panicle diameter of the main stem (mm)	8.263617708	7.762789225	7.654800034	0.557785186	0.643698667	0.642906507	0.305821728	0.385314823	0.403111393	122.3448173	117.0937918	61.49637699
Millet	Panicle length of the main stem (cm)	4.489892169	4.530021076	4.338630581	0.504680071	0.525036812	0.563143867	0.248066604	0.240115095	0.29855375	15.72001808	15.81286119	12.35742211
Millet	Main stem panicle weight (g)	5.593722892	5.571382355	5.424616432	0.342951898	0.376669702	0.417994702	0.10572965	0.112989711	0.159015811	38.12568844	39.56387349	28.03674176
Millet	Spikelet number of the main stem	16.17611509	15.99974259	15.65772715	0.341175887	0.349809947	0.410523646	0.098844061	0.121362129	0.154274366	15.91609629	15.82131435	14.25707504
Millet	Main stem width (mm)	1.653036615	1.642143265	1.566786337	0.581987017	0.621255816	0.648063679	0.327798391	0.337613006	0.397294804	112.991569	109.6628757	27.78641954
Millet	Per plant grain weight (g)	4.867646321	4.827655623	4.763485909	0.30974004	0.327430354	0.375490206	0.080336124	0.097086304	0.119344123	43.50003319	43.80725231	30.39781243
Millet	Grain number per spike	27.90352472	27.83439399	27.3005209	0.402811185	0.42424121	0.464351495	0.156198192	0.159895614	0.189805178	32.8028669	33.58787731	29.54651341
Millet	Top second leaf length (cm)	6.700005866	6.739517938	6.428706741	0.44948201	0.453728516	0.52058009	0.187943078	0.182906452	0.252711773	12.79358708	12.77375667	10.75844176
Millet	Top second leaf width (cm)	0.311128677	0.306352743	0.297674829	0.394052487	0.433597715	0.468086047	0.132963721	0.162226461	0.207430966	9.51073366	9.462172639	2.220997065
Pigeon	Body length (cm)	0.680635885	0.70893373	0.680635881	0.440281643	0.384464183	0.440281621	0.290230291	0.12135273	0.190230268	3.571671608	3.718121874	3.571671564
Pigeon	Chest width (mm)	3.884155814	3.97112819	3.861055589	0.4673308	0.49405807	0.49800287	0.215495493	0.182509099	0.225426811	4.794705836	4.850144492	3.834148012
Pigeon	Keel length (cm)	0.406516693	0.417499784	0.405470335	0.355304074	0.311218322	0.37516694	0.128287901	0.082018082	0.13398519	3.899097441	3.963493509	1.170898713
Pigeon	Pectoralis thickness (mm)	1.655053308	1.6405734	1.626149356	0.381060973	0.408242346	0.408242367	0.128435211	0.145409602	0.159388404	6.977069209	7.014310806	4.42624215
Pigeon	Shin length (mm)	1.987523016	2.064912384	1.98224566	0.428066091	0.361923838	0.442375147	0.169326526	0.103500631	0.173299116	3.936006652	4.015825735	2.662337814
Pigeon	Body weight (g)	72.71953865	78.00662493	72.71954002	0.519699239	0.452869294	0.519699216	0.259978849	0.151860042	0.259978837	9.437700483	10.15787964	9.437700585
Soybean	Plant height (cm)	20.76310914	24.88384515	20.36606522	0.792465109	0.738518995	0.799662423	0.618201102	0.459508291	0.633429176	20.41214932	23.48303472	19.18097854
Soybean	Protein content (µg/mg)	24.39098957	24.46270109	24.08569298	0.314678677	0.323298201	0.349842382	0.090897514	0.08603474	0.114655328	5.493528002	5.471829136	5.141216628
Rapeseed	C16:0 (%)	0.348253499	0.459381634	0.340588516	0.8002563	0.747764705	0.800256299	0.606987314	0.329953643	0.624837541	6.958936367	10.09020234	2.439839356
Rapeseed													

Supplemental Table 3. Result of E3.1 to E3.5																							
Dataset	Trait	RMSE					r					R-squre					MAPE						
		E3.1	E3.2	E3.3	E3.4	E3.5	E3.1	E3.2	E3.3	E3.4	E3.5	E3.1	E3.2	E3.3	E3.4	E3.5	E3.1	E3.2	E3.3	E3.4	E3.5		
Soybean	Beginning of blooming date (day)	9.88169	9.71210	9.64294	9.85324	9.61225	0.82187	0.82698	0.83033	0.82070	0.83094	0.66855	0.68007	0.68453	0.67038	0.68657	12.89193	12.54893	11.51434	12.62853	11.71699		
Cotton	fiber elongation rate	0.68321	0.66848	0.66848	0.68595	0.66848	0.69644	0.71047	0.71047	0.69196	0.71047	0.47691	0.49984	0.49984	0.47267	0.49984	5.36141	5.32512	5.32512	5.51771	5.32512		
Cotton	Fiber length (mm)	1.00945	1.00934	0.99579	1.01969	0.99214	0.78622	0.78697	0.79332	0.77989	0.79448	0.61312	0.61391	0.62329	0.60437	0.62591	2.65890	2.65236	1.61300	2.66569	1.61312		
Cotton	Fiber micronaire	0.27136	0.26535	0.26535	0.27715	0.26535	0.59940	0.62265	0.62265	0.58086	0.62265	0.35330	0.38160	0.38160	0.32618	0.38160	4.60704	4.50412	4.50412	4.67758	4.50412		
Cotton	Fiber strength (cN tex^-1)	1.17774	1.16200	1.15006	1.18731	1.14848	0.74792	0.76281	0.76343	0.75011	0.76470	0.55437	0.56783	0.57393	0.54898	0.57504	3.18910	3.08924	1.98820	3.15965	1.98676		
Wheat	Stripe rust disease severity (%)	26.97057	27.53010	26.82354	26.98486	26.71334	0.47323	0.41520	0.46001	0.44162	0.47767	0.21192	0.16126	0.20313	0.19262	0.20937							
Soybean	C16 fatty acid content (µg/mg)	2.68630	2.65668	2.64669	2.73844	2.64669	0.62175	0.62449	0.63330	0.60284	0.63330	0.37274	0.38750	0.39334	0.35196	0.39334	9.19715	9.03099	6.80375	9.34657	6.80375		
Soybean	C18 fatty acid content (µg/mg)	1.04602	0.99855	0.98923	1.00108	0.98016	0.63073	0.67511	0.67511	0.67981	0.68647	0.38684	0.44313	0.45296	0.43926	0.46305	13.94196	13.64829	7.41002	13.74804	7.23371		
Soybean	Total fatty acid content (µg/mg)	19.35941	19.12661	19.09439	19.79895	19.05896	0.61671	0.63231	0.63231	0.54856	0.63535	0.37188	0.38672	0.38743	0.34100	0.39270	8.04723	7.97350	7.63782	8.25154	7.61021		
Soybean	100-seed weight (g)	3.02606	3.04359	2.96585	3.17035	2.93790	0.69511	0.69886	0.71039	0.65466	0.71298	0.47472	0.47098	0.49555	0.41747	0.50499	16.02004	16.09668	12.14748	16.62077	12.28411		
Soybean	Leaf length (cm)	1.04908	1.05474	1.04411	1.06607	1.04306	0.45597	0.44942	0.46215	0.42720	0.46143	0.19651	0.18935	0.20350	0.16913	0.20324	9.23788	9.24281	4.81176	9.33940	4.80448		
Soybean	Leaf width (cm)	0.93818	0.94670	0.93818	0.97344	0.93818	0.62893	0.62595	0.62893	0.59536	0.62893	0.39644	0.38305	0.39644	0.34805	0.39644	12.44054	12.50368	12.44054	12.90904	12.44054		
Maize	al between anthesis and tasseling	0.71852	0.73131	0.70123	0.73262	0.69800	0.58087	0.56752	0.59899	0.57162	0.60285	0.31982	0.29597	0.35218	0.29251	0.35814	18.21040	18.77254	7.72557	18.72563	7.69034		
Maize	cob weight (g)	3.60876	3.64504	3.55434	3.69957	3.54400	0.49648	0.48606	0.51685	0.45471	0.51524	0.23198	0.21692	0.25484	0.19147	0.25875	14.49654	14.75086	11.10744	15.01336	11.44659		
Maize	Days to anthesis (day)	1.77788	1.78278	1.74175	1.78702	1.72985	0.58499	0.59150	0.60963	0.58587	0.61230	0.33614	0.33481	0.36213	0.32979	0.37165	1.97158	1.98517	1.32051	1.98903	1.31503		
Maize	Days to silking (day)	1.99588	1.99563	1.95540	1.98949	1.94610	0.53304	0.53862	0.55786	0.53885	0.56299	0.26986	0.27019	0.29664	0.27419	0.30221	2.11177	2.11948	1.44062	2.11567	1.45643		
Maize	Days to tasseling (day)	2.13855	2.16085	2.13260	2.17875	2.11523	0.58269	0.57846	0.59913	0.56933	0.59780	0.33230	0.31794	0.33462	0.30657	0.34717	2.48572	2.53590	1.78436	2.54613	1.77919		
Maize	Ear diameter (cm)	0.22102	0.22337	0.21944	0.22264	0.21813	0.46299	0.45273	0.47991	0.46634	0.49034	0.20339	0.18555	0.21219	0.19167	0.22218	4.16710	4.18712	0.81675	4.19278	0.81387		
Maize	Ear height (cm)	10.42625	10.58680	10.26347	10.59964	10.26347	0.59729	0.57842	0.60708	0.57308	0.60708	0.34394	0.32334	0.36399	0.32194	0.36399	10.17570	10.38221	9.11096	10.38422	9.11096		
Maize	Ear length (cm)	1.18615	1.20355	1.17389	1.23581	1.17306	0.52710	0.52015	0.54432	0.48249	0.54452	0.27418	0.25249	0.28707	0.21287	0.28840	6.92626	6.97851	3.93468	7.18241	3.95930		
Maize	Ear leaf length (cm)	4.87495	4.95912	4.78860	4.95146	4.78860	0.59814	0.57904	0.61121	0.58323	0.61121	0.34627	0.32256	0.36888	0.32452	0.36888	4.94172	5.00511	4.11810	5.00526	4.11810		
Maize	Ear leaf width (cm)	0.65165	0.65991	0.63978	0.65542	0.63697	0.62201	0.61637	0.63888	0.61923	0.64106	0.38001	0.36544	0.40169	0.37329	0.40682	5.55769	5.63470	2.45039	5.59879	2.44199		
Maize	Ear row number	1.14020	1.14245	1.12012	1.14269	1.11550	0.61992	0.61996	0.63231	0.62269	0.63637	0.36931	0.36688	0.39122	0.36668	0.39629	6.14057	6.17603	3.53151	6.13130	3.51357		
Maize	Ear weight (g)	14.24739	14.56383	14.24739	14.50882	14.18612	0.42516	0.39144	0.42516	0.38232	0.44831	0.16604	0.13007	0.16604	0.13639	0.17197	13.06555	13.30172	13.06555	13.37345	11.84914		
Maize	Kernel number per ear	49.51645	49.78063	49.04880	49.51648	48.74																	

Dataset			RMSE										r										R-squre										MAPE									
Trait	E4.1	E4.2	E4.3	E4.4	E4.5	E4.6	E4.7	E4.8	E4.9	E4.1	E4.2	E4.3	E4.4	E4.5	E4.6	E4.7	E4.8	E4.9	E4.1	E4.2	E4.3	E4.4	E4.5	E4.6	E4.7	E4.8	E4.9	E4.1	E4.2	E4.3	E4.4	E4.5	E4.6	E4.7	E4.8	E4.9						
Soybean	flower blooming	9.88169	10.31070	9.83293	10.20291	9.62150	14.35045	9.62150	11.07852	9.62150	0.82187	0.80348	0.82187	0.80784	0.82977	0.59790	0.82977	0.76755	0.82977	0.66855	0.63653	0.67113	0.64708	0.68546	0.29707	0.68546	0.58450	0.68546	12.89193	13.05106	12.12789	12.62789	11.29038	21.05865	11.29038	14.00536	11.29038					
Cotton	elongation	0.68321	0.70829	0.68321	0.68172	0.66348	0.69160	0.66348	0.72351	0.66348	0.69644	0.67699	0.69644	0.70160	0.71957	0.68265	0.71957	0.65484	0.71957	0.47691	0.43768	0.47691	0.48004	0.50754	0.46212	0.50754	0.41492	0.50754	5.36141	5.60147	5.36141	5.39920	2.55101	5.59734	2.55101	5.76368	2.55101					
Cotton	er length (mm)	0.00945	0.00945	0.00945	0.02815	0.99398	0.99398	0.99398	0.99398	0.99398	0.78622	0.75492	0.78622	0.77524	0.79232	0.76551	0.79130	0.79721	0.79175	0.65132	0.56122	0.65132	0.59766	0.62917	0.57104	0.62488	0.57688	0.63048	2.65890	2.82558	2.65890	2.65810	1.60850	4.28480	1.61293	2.78421	1.59523					
Cotton	er micro length (mm)	0.27136	0.27229	0.27136	0.27136	0.02694	0.02694	0.02694	0.02694	0.02694	0.59940	0.56768	0.59940	0.60979	0.69531	0.56555	0.61945	0.57622	0.61945	0.61330	0.30053	0.61330	0.35240	0.65428	0.37146	0.36403	0.34312	0.36043	4.60704	4.73586	4.60704	4.65450	1.14614	2.87450	1.14313	4.64722	1.14313					
Cotton	length (cm)	1.17774	1.22872	1.17774	1.16495	1.15012	1.20957	1.14540	1.20483	1.13662	0.74792	0.73024	0.74792	0.75879	0.76858	0.73587	0.76935	0.74167	0.77335	0.55437	0.51291	0.55437	0.56859	0.57609	0.53272	0.57970	0.53468	0.58570	3.18910	3.29552	3.18910	3.12189	1.97832	3.24925	1.97900	3.24873	1.95867					
Wheat	disease score	26.97057	28.29017	26.82354	26.36416	26.26908	32.73137	26.26908	26.61720	26.00816	0.47323	0.43551	0.46001	0.48764	0.49757	0.27707	0.49757	0.48113	0.51689	0.21192	0.10922	0.20313	0.22963	0.23527	-0.20410	0.23527	0.21503	0.24924														
Soybean	acid content	2.68630	2.58013	2.68630	2.82815	2.98732	2.78451	2.98732	2.78451	2.98732	0.62175	0.58186	0.62175	0.59848	0.62483	0.58975	0.62483	0.51825	0.62483	0.37274	0.29211	0.37274	0.34405	0.43726	0.32720	0.43726	0.37326	0.37326	9.91715	9.75433	9.91715	9.47717	6.87587	9.37880	6.87587	9.87448	6.87587					
Soybean	acid content	0.14602	0.12823	0.10663	0.99973	0.69812	1.18535	0.69812	1.18535	0.69812	0.63075	0.58286	0.66426	0.67599	0.62483	0.50823	0.62483	0.56374	0.62483	0.37684	0.40947	0.47217	0.44003	0.44574	0.22165	0.45045	0.30441	0.45798	13.94196	13.63407	9.46121	13.34443	7.28753	16.27376	7.32545	15.14541	6.37161					
Soybean	acid content	19.35941	19.77558	19.35941	19.25209	18.95245	21.38739	18.95245	20.35397	18.91241	0.61671	0.61737	0.61671	0.63473	0.64429	0.52397	0.64429	0.57333	0.64752	0.37188	0.34134	0.37188	0.37745	0.39618	0.22269	0.39618	0.30158	0.39808	8.04723	8.21956	8.04723	7.94966	7.47793	9.03655	7.47793	8.52068	7.54081					
Soybean	seed weight	3.02606	2.97135	2.90586	2.90787	2.82643	2.90874	2.74289	3.27402	2.74289	0.69511	0.71088	0.72257	0.72989	0.74142	0.72288	0.75894	0.62625	0.75894	0.47472	0.48984	0.51248	0.51587	0.54230	0.51120	0.56699	0.38895	0.56699	16.02004	16.34800	12.23851	15.96968	11.73868	15.76129	11.42500	17.08959	11.42500					
Soybean	af length (cm)	0.104908	0.104908	0.104908	0.107008	0.04908	1.10211	0.04908	1.10211	0.04908	0.45597	0.36505	0.45597	0.41887	0.45597	0.38654	0.45597	0.33625	0.46360	0.19651	0.02159	0.19651	0.19193	0.19651	0.10761	0.19651	0.10189	0.20940	9.23788	9.95918	9.23788	9.39200	6.23858	9.71378	9.23788	9.69036	4.81302					
Soybean	af width (cm)	0.93818	1.19457	0.93818	0.93959	0.92360	1.02064	0.92360	0.95652	0.92083	0.62893	0.58067	0.62893	0.63078	0.64527	0.56380	0.64527	0.61713	0.65096	0.39644	0.32137	0.39644	0.39144	0.41054	0.28894	0.41054	0.37145	0.41621	12.44054	13.15647	12.44054	13.92598	9.23852	17.12993	6.28252	12.48450	6.28141					
Maize	anthesis at	0.71852	0.71345	0.69734	0.68985	0.68258	0.73417	0.68231	0.71713	0.68231	0.58087	0.59010	0.60821	0.61758	0.62759	0.55162	0.62826	0.57659	0.62826	0.31982	0.32744	0.35817	0.37377	0.38634	0.28583	0.38658	0.32322	0.38658	18.21040	17.56782	7.61922	17.25471	7.54811	19.16824	7.64114	17.89526	7.64114					
Maize	jb weight (g)	3.60876	3.55685	3.48626	3.45976	3.42784	3.93157	3.42784	3.78555	3.41610	0.49648	0.53098	0.54866	0.55079	0.55961	0.38350	0.55961	0.40606	0.56245	0.23198	0.25143	0.28209	0.29314	0.30556	0.08271	0.30556	0.15323	0.30967	14.49654	14.23700	10.93732	13.92866	10.73559	16.18849	10.73559	15.14095	10.88915					
Maize	to silencing	1.77788	1.76554	1.72891	1.73772	1.70661	2.00349	1.70661	1.87463	1.69846	0.58499	0.60728	0.62072	0.61665	0.62881	0.43822	0.62881	0.52509	0.63050	0.33614	0.34195	0.38679	0.36522	0.38563	0.15576	0.38563	0.26054	0.39228	1.97158	1.91534	1.29796	1.90676	1.28786	2.23233	1.28786	2.08002	1.29010					
Maize	to tasseling	1.93585	2.02574	1.92880	1.94697	1.92903	2.25695	1.92903	2.09411	1.92411	0.53304	0.53813	0.55619	0.56686	0.57822	0.40630	0.57822	0.47263	0.58071	0.26986	0.24482	0.28629	0.30491	0.31597	0.07183	0.31597	0.16647	0.31828	2.11177	2.13576	1.45504	2.04517	1.42114	2.42948	1.42114	2.21525	1.43558					
Maize	diameter (cm)	2.13855	2.18036	2.13365	2.08332	2.06284	2.26961	2.05042	2.26365	2.03683	0.58269	0.58457	0.60433	0.61607	0.63040	0.52490	0.62706	0.51428	0.63445	0.33230	0.30250	0.33253	0.36374	0.37540	0.24623	0.38499	0.25035	0.39275	2.48572	2.51354	1.78096	2.43311	1.73709	2.66294	1.73129	2.65875	1.71631					
Maize	diameter (cm)	0.22102	0.23018	0.22076	0.21694	0.21635	0.24325	0.21635	0.22940	0.21622	0.46299	0.45236	0.46299	0.49846	0.50668	0.39591	0.50668	0.39468	0.50614	0.20339	0.12939	0.20384	0.22848	0.23245	0.02859	0.23245	0.14006	0.23307	4.16710	4.30620	0.82928	4.05524	0.80545	4.64037	0.80545	4.35091	0.80642					
Maize	r height (cm)	10.42625	10.60540	10.31640	10.05936	9.95080	11.35743	9.95080	11.01891	9.95080	0.59729	0.59389	0.61320	0.62984	0.63726	0.52111	0.63726	0.53008	0.63726	0.34394	0.31616	0.35558	0.38744	0.40063	0.21976	0.40063	0.26540	0.40063	10.17570	10.12508	9.90680	9.64466	8.79378	11.48041	8.79378	10.75521	8.79378					
Maize	leaf length (cm)	1.86145	1.80495	1.71459	1.76215	1.47464	1.72025	1.47464	1.72049	1.42883	0.52710	0.53453	0.55524	0.56087	0.57245	0.43003	0.57245	0.49218	0.57983	0.27418	0.24146	0.28616	0.30179	0.31780	0.16647	0.31780	0.16646	0.32366	6.92162	7.05807	3.94716	6.83232	3.94716	7.48002	3.88385	7.46659	3.87138					
Maize	leaf length (cm)	4.87495	4.85946	4.76551	4.76412	4.68783	5.25770	4.68783	5.27452	4.68783	0.59814	0.60920	0.62546	0.61436	0.63299	0.51469	0.63299	0.49479	0.63299	0.34627	0.34754	0.37340	0.37333	0.39399	0.23083	0.39399	0.23342	0.39399	9.94172	4.83309	4.06310	4.75891	4.08185	5.24476	4.08185	5.36514	4.08185					
Maize	leaf width (cm)	0.65165	0.65369	0.63980	0.62979	0.62155	0.67158	0.62155	0.69429	0.61688	0.62201	0.62715	0.64263	0.65214	0.66348	0.59661	0.66348	0.55554	0.67070	0.38001	0.37340	0.39973	0.41993	0.43357	0.34125	0.43357	0.29254	0.44013	5.55769	5.49155	2.43633	5.30539	2.38463	5.76288	2.38463	5.84352	2.36764					
Maize	r row num	1.14020	1.15307	1.12375	1.10754	1.09547	1.47091	1.09547	1.47091	1.09547	0.61992	0.61226	0.63283	0.64405	0.65376	0.42616	0.65376	0.55052	0.65542	0.36931	0.35242	0.38614	0.40346	0.41675	-0.08371	0.41675	0.29156	0.41794	6.14057	6.16753	3.52348	5.89407	3.44469	8.35982	3.44469	6.49200	3.45674					
Maize	ar weight (g)	14.24739	14.00234	14.42539	14.05956	14.03651	15.82066	14.03651	15.82066	14.03651	0.42516	0.41590	0.42516	0.45843	0.46998	0.26231	0.46998	0.26231	0.47190	0.16604	0.19680	0.16604	0.18647	0.18675	-0.03623	0.19686	0.15737	0.20064	13.06555	13.20641	13.06555	12.63258	14.49885	12.63258	14.38088	11.81788						
Maize	l number p	49.51645	50.82813	48.95283	48.08995	47.92744	54.72927	47.92744	54.97108	47.92938	0.43219	0.45692	0.47066	0.48385	0.49000	0.31975	0.49392	0.40574	0.50033	0.16911	0.14698	0.18379	0.21643	0.21913	-0.01586	0.22588	0.15237	0.23153	13.48339	13.54349	12.86031	12.99883	12.60103	15.61353	12.78144	13.60460	12.66021					
Maize	l number p	2.63409	2.65838	2.60231	2.59077	2.56832	2.96048	2.55573	2.74440	2.54236	0.50226	0.51960	0.53444	0.52805	0.54298	0.33341	0.54428	0.43443	0.55398	0.23763	0.22148	0.25291	0.25923	0.27102	0.03507	0.27965	0.16918	0.28592	10.27713	10.26579	7.43274	10.07403	7.35087	11.59910	7.42911	10.63356	7.27384					
Maize	weight per	9.77723	10.05462	9.77723	9.66054	9.57179	10.20406	9.57179	10.23658	9.57179	0.43339	0.44493	0.43339	0.46119	0.47783	0.37170	0.47783	0.33720	0.47783	0.17405	0.12123	0.174																				

Supplemental Table 5. Result of E5.1 to E5.10

Dataset	Trait	RMSE										r										R-squre										MAPE									
		E5.1	E5.2	E5.3	E5.4	E5.5	E5.6	E5.7	E5.8	E5.9	E5.10	E5.1	E5.2	E5.3	E5.4	E5.5	E5.6	E5.7	E5.8	E5.9	E5.10	E5.1	E5.2	E5.3	E5.4	E5.5	E5.6	E5.7	E5.8	E5.9	E5.10	E5.1	E5.2	E5.3	E5.4	E5.5	E5.6	E5.7	E5.8	E5.9	E5.10
Soybean	of bloomin	9.88169	9.83293	9.62150	9.62150	9.62150	9.88169	9.87154	9.88795	9.75063	9.73028	0.82187	0.82187	0.82977	0.82977	0.82977	0.82187	0.82048	0.81986	0.82503	0.82584	0.66855	0.67113	0.68546	0.68546	0.68546	0.66855	0.66805	0.66657	0.67698	0.67836	12.89193	12.12789	11.29038	11.29038	11.29038	12.89193	12.58479	12.76105	12.41256	12.41942
Cotton	elongation	0.68321	0.68321	0.66348	0.66348	0.66348	0.68321	0.69087	0.68970	0.67963	0.67332	0.69644	0.69644	0.71957	0.71957	0.71957	0.69644	0.69689	0.69769	0.70698	0.70879	0.47691	0.47691	0.50754	0.50754	0.50754	0.47691	0.46541	0.46640	0.48244	0.49131	5.36141	5.36141	2.55101	2.55101	2.55101	5.36141	5.41129	5.48838	5.34285	5.37327
Cotton	er length (c	1.00945	1.00945	0.99398	0.99352	0.98439	1.00945	1.03061	1.03278	1.01830	1.01079	0.78622	0.78622	0.79332	0.79310	0.79715	0.78622	0.77890	0.77688	0.78372	0.78319	0.61312	0.61312	0.62418	0.62488	0.63098	0.61312	0.59531	0.59423	0.60505	0.61167	2.65890	2.65890	1.60850	1.61293	1.59523	2.65890	2.70077	2.71496	2.68248	2.67883
Cotton	er microna	0.27136	0.27136	0.26964	0.26956	0.26956	0.27136	0.27832	0.27257	0.27033	0.27009	0.59940	0.59940	0.62521	0.61945	0.61945	0.59940	0.59456	0.61417	0.61105	0.60825	0.35330	0.35330	0.35927	0.36043	0.36043	0.35330	0.31913	0.34474	0.35694	0.35807	4.60704	4.60704	1.14614	1.14313	1.14313	4.60704	4.68193	4.59774	4.59135	4.57203
Cotton	rength (cN)	1.17774	1.17774	1.15012	1.14540	1.13662	1.17774	1.19946	1.20116	1.18061	1.16745	0.74792	0.74792	0.76858	0.76935	0.77335	0.74792	0.74807	0.74695	0.75585	0.75303	0.55437	0.55437	0.57609	0.57970	0.58570	0.55437	0.53428	0.53317	0.54993	0.56115	3.18910	3.18910	1.97832	1.97900	1.95867	3.18910	3.19507	3.21450	3.16077	3.14391
Wheat	disease sc	26.97057	26.82354	26.26908	26.26908	26.0816	26.97057	27.40848	27.78494	27.26991	27.16259	0.47323	0.46001	0.49757	0.49757	0.51689	0.47323	0.46478	0.46324	0.47170	0.46585	0.21192	0.20313	0.23527	0.23527	0.24924	0.21192	0.16651	0.14149	0.17339	0.18117	9.19715	9.19715	6.87587	6.87587	6.87587	9.19715	9.29588	9.54683	9.16360	9.30844
Soybean	acid conte	2.68630	2.68630	2.67821	2.67821	2.67821	2.68630	2.75390	2.78590	2.73362	2.72508	0.62175	0.62175	0.62483	0.62483	0.62483	0.62175	0.60938	0.60713	0.61576	0.61477	0.37274	0.37274	0.37326	0.37326	0.37326	0.37274	0.33962	0.32086	0.34952	0.35213	13.94196	13.94196	7.28753	7.32545	7.37161	13.94196	13.30165	13.38263	13.11414	13.27407
Soybean	acid conte	19.35941	19.35941	18.95245	18.95245	18.91241	19.35941	19.38407	19.45578	19.28064	19.11643	0.61671	0.61671	0.64429	0.64429	0.64752	0.61671	0.63014	0.62888	0.62990	0.63229	0.37188	0.37188	0.39618	0.39618	0.39808	0.37188	0.36886	0.36201	0.37728	0.38754	8.04723	8.04723	7.47793	7.54081	8.04723	8.02462	8.08834	7.99254	7.98755	
Soybean	seed weigh	3.02606	2.90586	2.82643	2.74289	2.74289	3.02606	2.90586	2.88166	2.79219	2.78969	0.69511	0.72257	0.74142	0.75894	0.75894	0.69511	0.72257	0.72784	0.74689	0.74496	0.47472	0.51248	0.54230	0.56699	0.56699	0.47472	0.51248	0.51940	0.54968	0.55050	16.02004	12.23851	11.73868	11.42500	11.42500	16.02004	15.81076	15.89908	15.19649	15.46095
Soybean	af length (c	1.04908	1.04908	1.04908	1.04908	1.03850	1.04908	1.09985	1.11867	1.08032	1.07700	0.45597	0.45597	0.45597	0.45597	0.46360	0.45597	0.41231	0.40277	0.42829	0.42277	0.19651	0.19651	0.19651	0.19651	0.20940	0.19651	0.10689	0.07497	0.13941	0.14859	9.23788	9.23788	9.23788	9.23788	4.81302	9.23788	9.49142	9.75784	9.29291	9.49405
Soybean	af width (c	0.93818	0.93818	0.92360	0.92360	0.92083	0.93818	0.96763	0.97209	0.96249	0.95505	0.62893	0.62893	0.64527	0.64527	0.65096	0.62893	0.61296	0.60823	0.61686	0.61418	0.39644	0.39644	0.41054	0.41054	0.41621	0.39644	0.35453	0.34869	0.36272	0.37400	12.44054	12.44054	6.28252	6.28252	6.29412	12.44054	12.52407	12.96194	12.53579	12.74024
Maize	anthesis at	0.71852	0.69734	0.68258	0.68231	0.68231	0.71852	0.69734	0.69984	0.69121	0.68916	0.58087	0.60821	0.62759	0.62826	0.62826	0.58087	0.60821	0.60872	0.61698	0.61597	0.31982	0.35817	0.38634	0.38658	0.38658	0.31982	0.35817	0.35326	0.36833	0.37225	18.21040	7.61922	7.54811	7.64114	7.64114	18.21040	17.01254	17.46832	17.10473	17.27430
Maize	wb weight (	3.60876	3.48626	3.42784	3.42784	3.41610	3.60876	3.48626	3.48089	3.48070	3.46320	0.49648	0.54866	0.55961	0.55961	0.56245	0.49648	0.54866	0.55233	0.55179	0.54668	0.23198	0.28209	0.30550																	

Supplemental Table 6. Result of E2.3, E3.5, E4.9, and E6.1

Dataset	Trait	RMSE				r				R-squre				MAPE			
		E2.3	E3.5	E4.9	E6.1	E2.3	E3.5	E4.9	E6.1	E2.3	E3.5	E4.9	E6.1	E2.3	E3.5	E4.9	E6.1
Soybean	of bloomin	9.45223	9.61225	9.62150	9.10924	0.83799	0.83094	0.82977	0.84909	0.69837	0.68657	0.68546	0.71866	11.30154	11.71699	11.29038	10.88687
Cotton	elongation	0.67273	0.66848	0.66348	0.65940	0.70667	0.71047	0.71957	0.72380	0.49319	0.49984	0.50754	0.51412	2.58338	5.32512	2.55101	2.54953
Cotton	er length (n	0.96305	0.99214	0.98439	0.94267	0.80752	0.79448	0.79715	0.81492	0.64870	0.62591	0.63098	0.66219	1.55246	1.61312	1.59523	1.52361
Cotton	er microns	0.24290	0.26535	0.26956	0.23709	0.70012	0.62265	0.61945	0.71718	0.48281	0.38160	0.36043	0.50658	1.02173	4.50412	1.14313	1.00033
Cotton	rength (cN	1.04170	1.14848	1.13662	1.02441	0.81230	0.76470	0.77335	0.82008	0.65507	0.57504	0.58570	0.66708	1.78574	1.98676	1.95867	1.77220
Wheat	disease se	26.54566	26.71334	26.00816	25.63371	0.48086	0.47767	0.51689	0.52908	0.22011	0.20937	0.24924	0.27151				
Soybean	acid conte	2.60819	2.64669	2.67821	2.59411	0.64153	0.63330	0.62483	0.64570	0.41068	0.39334	0.37326	0.41655	6.71968	6.80375	6.87587	6.66358
Soybean	acid conte	0.85347	0.98016	0.98395	0.83129	0.78136	0.68647	0.68612	0.79353	0.59280	0.46305	0.45798	0.61298	6.20614	7.23371	7.37161	6.04260
Soybean	acid conte	18.51460	19.05896	18.91241	18.07655	0.65851	0.63535	0.64752	0.67625	0.42538	0.39270	0.39808	0.45113	7.33738	7.61021	7.54081	7.19678
Soybean	seed weigh	2.89476	2.93790	2.74289	2.57773	0.73770	0.71298	0.75894	0.79001	0.52008	0.50499	0.56699	0.61503	11.38733	12.28411	11.42500	10.90752
Soybean	af length (c	1.02934	1.04306	1.03850	1.01217	0.47700	0.46143	0.46360	0.49590	0.22401	0.20324	0.20940	0.24740	4.74898	4.80448	4.81302	4.69885
Soybean	af width (c	0.93818	0.93818	0.92083	0.90483	0.62893	0.62893	0.65096	0.66210	0.39644	0.39644	0.41621	0.43514	12.44054	12.44054	6.29412	6.26506
Maize	anthesis an	0.68856	0.69800	0.68231	0.66482	0.61543	0.60285	0.62826	0.65189	0.37556	0.35814	0.38658	0.41772	7.60446	7.69034	7.64114	7.39528
Maize	ob weight (	3.36868	3.54400	3.41610	3.07653	0.57905	0.51524	0.56245	0.66807	0.33018	0.25875	0.30967	0.44106	10.56087	11.44659	10.88915	9.80062
Maize	to anthesis	1.68950	1.72985	1.69896	1.60867	0.64094	0.61230	0.63050	0.67821	0.40136	0.37165	0.39228	0.45640	1.27413	1.31503	1.29010	1.21420
Maize	to silking	1.89051	1.94610	1.92411	1.76483	0.59591	0.56299	0.58071	0.65841	0.34483	0.30221	0.31829	0.42610	1.40033	1.45643	1.43558	1.31935
Maize	o tasseling	2.01028	2.11523	2.03683	1.90091	0.65023	0.59780	0.63445	0.68935	0.41040	0.34717	0.39275	0.47097	1.68055	1.77919	1.71631	1.59571
Maize	diameter (	0.20908	0.21813	0.21622	0.19984	0.54386	0.49034	0.50614	0.59238	0.28448	0.22218	0.23307	0.34602	0.78142	0.81387	0.80642	0.74569
Maize	r height (c	9.63568	10.26347	9.95080	9.31738	0.66303	0.60708	0.63726	0.69031	0.43870	0.36399	0.40063	0.47399	8.58041	9.11096	8.79378	8.21714
Maize	r length (c	1.13440	1.17306	1.14283	1.07147	0.58586	0.54452	0.57983	0.64025	0.33533	0.28840	0.32366	0.40342	3.80141	3.95930	3.87138	3.61630
Maize	leaf length	4.50526	4.78860	4.68783	4.27232	0.66512	0.61121	0.63299	0.70743	0.44076	0.36888	0.39399	0.49683	3.88502	4.11810	4.01835	3.67824
Maize	leaf width	0.62150	0.63697	0.61688	0.59740	0.65985	0.64106	0.67070	0.69447	0.43438	0.40682	0.44013	0.47447	2.37335	2.44199	2.36764	2.26470
Maize	r row num	1.09031	1.11550	1.09426	1.02739	0.65576	0.63637	0.65542	0.70138	0.42230	0.39629	0.41794	0.48584	3.41835	3.51357	3.45674	3.22459
Maize	ar weight (	13.80796	14.18612	13.93422	13.21024	0.48580	0.44831	0.47190	0.54076	0.21593	0.17197	0.20064	0.28244	11.49847	11.84914	11.81788	11.16919
Maize	l number p	47.49799	48.74814	47.52938	45.41246	0.49407	0.45725	0.50033	0.55206	0.23351	0.19370	0.23153	0.29971	12.32528	13.04690	12.66021	11.91076
Maize	l number p	2.52825	2.60385	2.54236	2.44477	0.55204	0.52345	0.55398	0.58917	0.29447	0.25165	0.28592	0.33904	7.25832	7.44608	7.27384	7.05064
Maize	weight per	9.52044	9.74854	9.57179	9.18357	0.47511	0.45007	0.47783	0.52835	0.21411	0.17692	0.20561	0.27003	9.97976	10.14310	9.95381	9.76585
Maize	of barren t	0.37142	0.38181	0.37656	0.35724	0.50660	0.46324	0.49500	0.55478	0.25042	0.21026	0.23113	0.30573	7.27843	28.84783	7.27807	7.05854
Maize	umber abc	0.40168	0.41940	0.40729	0.38316	0.65203	0.61095	0.63709	0.69124	0.42119	0.36529	0.40075	0.47079	1.69691	1.76161	1.69644	1.60562
Maize	umber bel	0.53754	0.56637	0.55983	0.51346	0.65919	0.61104	0.62605	0.69551	0.43199	0.36788	0.38025	0.48103	2.26319	2.39751	2.35516	2.15410
Maize	nt height (	14.88552	16.15691	15.59964	14.05728	0.66247	0.58977	0.62713	0.71153	0.43952	0.34019	0.38489	0.50164	5.31779	5.76131	5.59509	5.01569
Maize	silking an	1.10995	1.15765	1.11930	1.05062	0.53032	0.46363	0.51963	0.59246	0.26945	0.20488	0.25433	0.34261				
Maize	silking an	1.35838	1.40244	1.34742	1.28417	0.63842	0.61114	0.64765	0.68694	0.40271	0.36286	0.41191	0.46559	11.30057	11.63545	11.33667	10.86110
Maize	l branch nu	2.44406	2.61104	2.52612	2.27259	0.69405	0.64111	0.67369	0.74585	0.47810	0.40318	0.44180	0.54773	12.10852	12.76522	12.57519	11.40021
Maize	sel length (	2.80748	2.95686	2.90511	2.64422	0.72784	0.69236	0.70871	0.76183	0.52834	0.47440	0.49100	0.57878	5.25150	5.54103	5.40247	4.92118
Soybean	aturity dat	15.45548	15.63362	15.26614	14.94690	0.70210	0.69403	0.70931	0.72399	0.48699	0.47405	0.49701	0.52013	9.03904	9.56400	8.82424	8.59814
Millet	neck leng	5.27887	5.39000	5.32527	5.11578	0.57541	0.54608	0.56410	0.60738	0.32522	0.29143	0.30155	0.36134	9.41820	9.78737	9.91866	9.46276
Millet	l kernel we	0.29612	0.29614	0.29364	0.29261	0.43879	0.42683	0.43274	0.47011	0.17899	0.16066	0.15418	0.18691	4.01023	6.53707	4.64270	7.33425
Millet	stem heigh	13.37238	13.43672	13.19562	12.88873	0.37652	0.35189	0.40759	0.44082	0.12603	0.11915	0.14835	0.18724	9.54005	9.74287	9.51399	9.39633
Millet	er of the m	7.65480	8.01675	7.70366	7.12640	0.64291	0.59263	0.63550	0.69869	0.40311	0.34379	0.39506	0.48147	61.49638	118.51917	58.26784	52.44251
Millet	h of the ma	4.33863	4.33912	4.22671	4.15787	0.56314	0.54921	0.58588	0.60536	0.29855	0.29628	0.33046	0.35278	12.35742	12.50448	12.46563	12.08568
Millet	n panicle v	5.42462	5.56698	5.56698	5.35370	0.41799	0.34295	0.34295	0.42745	0.15902	0.11382	0.11382	0.18138	28.03674	30.31640	30.31640	28.86657
Millet	mber of th	15.65773	15.97504	15.72676	15.11439	0.41052	0.34118	0.38325	0.46218	0.15427	0.12170	0.14813	0.21385	14.25708	15.10976	14.79743	14.09606
Millet	stem width	1.56679	1.60072	1.57579	1.49733	0.64806	0.61802	0.62955	0.68067	0.39729	0.36963	0.38828	0.45009	27.78642	27.82690	27.55125	26.26353
Millet	at grain we	4.76349	4.85244	4.85809	4.64868	0.37549	0.29742	0.30974	0.40802	0.11934	0.08732	0.08365	0.16092	30.39781	32.34731	32.36191	30.44120
Millet	number pe	27.30052	27.16589	27.56301	26.71072	0.46435	0.45471	0.44242	0.47487	0.18981	0.19833	0.17133	0.22484	29.54651	30.71533	29.26760	29.89495
Millet	ond leaf len	6.42871	6.46936	6.43796	6.10296	0.52058	0.48814	0.50952	0.57988	0.25271	0.23870	0.24711	0.32686	10.75844	10.95407	10.88291	10.32159
Millet	ond leaf wi	0.29767	0.30481	0.30579	0.29368	0.46809	0.43007	0.42680	0.48628	0.20743	0.16741	0.16326	0.22788	2.22100	2.28155	2.27668	2.19612
Pigeon	ly length (	0.68064	0.67366	0.65863	0.64858	0.44028	0.45722	0.50151	0.53618	0.19023	0.20636	0.24055	0.26420	3.57167	1.51704	1.47643	1.45017
Pigeon	st width (n	3.86106	3.88416	3.84341	3.76607	0.49800	0.46733	0.49159	0.52670	0.22543	0.21550	0.23314	0.26298	3.83415	4.79471	3.81147	3.73674
Pigeon	el length (c	0.40547	0.40021	0.37154	0.37065	0.37517	0.40043	0.52954	0.53562	0.13399	0.15537	0.26984	0.27443	1.17090	1.15833	1.06068	1.06299
Pigeon	lis thickne	1.62615	1.60843	1.59864	1.58269	0.40824	0.42602	0.46337	0.47550	0.15939	0.17713	0.18854	0.20505	4.42624	6.82385	4.31931	4.27435
Pigeon	n length (n	1.98225	1.97219	1.91585	1.91897	0.44238	0.43191	0.49897	0.50817	0.17330	0.18202	0.22783	0.22596	2.66234	2.62505	2.57982	2.59103
Pigeon	dy weight	72.71954	72.24197	71.16389	70.79640	0.51970	0.52632	0.55824	0.56454	0.25998	0.26956	0.29178	0.29907	9.43770	9.14821	9.20131	8.96744
Soybean	nt height (	20.36607	20.16592	19.45612	19.34611	0.79966	0.80014	0.81791	0.82100	0.63343	0.63957	0.66658	0.67100	19.18098	19.03102	18.33964	18.03589
Soybean	i content (	24.08569	24.25531	24.21276	23.44366	0.34984	0.33147	0.33883	0.40025	0.11466	0.10280	0.10573	0.16103	5.14122	5.20535	5.21798	5.08253
Rapeseed	C16:0 (%)	0.34059	0.33432	0.32788	0.32961	0.80026	0.81216	0.81762	0.								

Supplemental Table 7. Result of E7.1 to E7.6

Dataset	Trait	RMSE						r						R-squre						MAPE					
		E7.1	E7.2	E7.3	E7.4	E7.5	E7.6	E7.1	E7.2	E7.3	E7.4	E7.5	E7.6	E7.1	E7.2	E7.3	E7.4	E7.5	E7.6	E7.1	E7.2	E7.3	E7.4	E7.5	E7.6
Soybean	of bloomin	9.88169	10.31070	10.20291	14.35045	11.07852	9.93528	0.82187	0.80348	0.80784	0.59790	0.76755	0.82600	0.66855	0.63653	0.64708	0.29707	0.58450	0.66698	12.89193	13.05106	12.62789	21.05865	14.00536	12.07801
Cotton	elongation	0.68321	0.70829	0.68172	0.69160	0.72351	0.70868	0.69644	0.67699	0.70160	0.68265	0.65484	0.66998	0.47691	0.43768	0.48004	0.46212	0.41492	0.43401	5.36141	5.60147	5.39920	5.59734	5.76368	5.71940
Cotton	er length (r	1.00945	1.07414	1.02865	1.06115	1.05278	1.07242	0.78622	0.75492	0.77524	0.76351	0.76721	0.76522	0.61312	0.56122	0.59766	0.57304	0.57688	0.56494	2.65890	2.82556	2.68450	2.82878	2.78241	2.79497
Cotton	er microns	0.27136	0.28229	0.27125	0.27980	0.27344	0.27991	0.59940	0.56768	0.60979	0.56555	0.59522	0.57186	0.35330	0.30053	0.35240	0.31146	0.34312	0.31040	4.60704	4.73988	4.55117	4.74540	4.64722	4.73427
Cotton	rength (cN	1.17774	1.22872	1.16495	1.20957	1.20483	1.31113	0.74792	0.73024	0.75879	0.73587	0.74167	0.71557	0.55437	0.51291	0.56859	0.53272	0.53468	0.45836	3.18910	3.29552	3.12189	3.24925	3.24873	3.42314
Wheat	disease se	26.97057	28.29017	26.36416	32.73137	26.61720	27.27990	0.47323	0.43551	0.48764	0.27707	0.48113	0.42620	0.21192	0.10922	0.22963	-0.20410	0.21503	0.17517						
Soybean	acid conte	2.68630	2.85013	2.78215	2.78415	2.89633	2.75560	0.62175	0.58181	0.59848	0.58975	0.51825	0.61373	0.37274	0.29211	0.32405	0.32720	0.27544	0.34012	9.19715	9.75433	9.47717	9.37880	9.87448	9.30026
Soybean	acid conte	1.04602	1.02823	0.99973	1.18535	1.11752	1.10651	0.63073	0.65286	0.67599	0.50823	0.56374	0.57058	0.38684	0.40947	0.44003	0.21665	0.30441	0.31141	13.94196	13.63407	13.34443	16.27376	15.14541	14.61549
Soybean	acid conte	19.35941	19.77558	19.25209	21.38739	20.35397	20.28591	0.61671	0.61737	0.63473	0.52397	0.57333	0.59800	0.37188	0.34134	0.37745	0.22269	0.30158	0.30536	8.04723	8.21956	7.94966	9.03655	8.52068	8.46415
Soybean	seed weigh	3.02606	2.97135	2.90787	2.90874	3.27402	3.15163	0.69511	0.71088	0.72989	0.72288	0.62625	0.66661	0.47472	0.48984	0.51587	0.51120	0.38895	0.43206	16.02004	16.34800	15.96968	15.76129	17.08959	16.43465
Soybean	af length (c	1.04908	1.14747	1.07008	1.10211	1.10195	1.05711	0.45597	0.36505	0.41887	0.38654	0.33625	0.46431	0.19651	0.02219	0.15939	0.10761	0.10819	0.18574	9.23788	9.95918	9.39200	9.71378	9.69036	9.33523
Soybean	af width (c	0.93818	0.99658	0.93959	1.02064	0.95652	0.94972	0.62893	0.58067	0.63038	0.56380	0.61713	0.62639	0.39644	0.31537	0.39144	0.28894	0.37145	0.37198	12.44054	13.15647	12.39598	13.71293	12.48450	12.45678
Maize	anthesis an	0.71852	0.71345	0.68985	0.73417	0.71713	0.74343	0.58087	0.59010	0.61758	0.55162	0.57659	0.53769	0.31982	0.32744	0.37377	0.28583	0.32322	0.27204	18.21040	17.56782	17.25471	19.16824	17.89526	18.26799
Maize	ob weight (c	3.60876	3.55685	3.45976	3.93157	3.78555	3.69306	0.49648	0.53098	0.55079	0.38350	0.40606	0.46924	0.23198	0.25143	0.29314	0.08271	0.15323	0.19636	14.49654	14.23700	13.92866	16.18849	15.14095	14.88211
Maize	to anthesis	1.77788	1.76555	1.73772	2.00349	1.87463	1.87785	0.58499	0.60728	0.61665	0.43822	0.52509	0.51185	0.33614	0.34195	0.36522	0.15576	0.26054	0.25713	1.97158	1.91534	1.90676	2.23233	2.08002	2.08491
Maize	to silking	1.99588	2.02574	1.94697	2.25695	2.09411	2.06892	0.53304	0.53813	0.56686	0.40630	0.47263	0.48993	0.26986	0.24482	0.30491	0.07183	0.19647	0.21808	2.11177	2.13576	2.04517	2.42948	2.21525	2.19751
Maize	o tasseling	2.13855	2.18036	2.08332	2.26961	2.26365	2.19811	0.58269	0.58457	0.61607	0.52490	0.51428	0.55186	0.33230	0.30250	0.36374	0.24623	0.25035	0.29583	2.48572	2.51354	2.43311	2.66294	2.65875	2.56926
Maize	diameter (r	0.22102	0.23018	0.21694	0.24325	0.22940	0.22147	0.46299	0.45236	0.49846	0.39591	0.39468	0.44564	0.20339	0.12939	0.22848	0.02859	0.14006	0.19701	4.16710	4.30620	4.05524	4.64037	4.35091	4.16825
Maize	r height (c	10.42625	10.60540	10.05936	11.35743	11.01891	11.10386	0.59729	0.59389	0.62984	0.52111	0.53008	0.51507	0.34394	0.31616	0.38744	0.21976	0.26540	0.25259	10.17570	10.12558	9.64461	11.48041	10.75521	11.05761
Maize	r length (c	1.18615	1.20495	1.16235	1.27025	1.27049	1.26069	0.52710	0.53453	0.56087	0.43003	0.42218	0.43970	0.27418	0.24146	0.30179	0.16499	0.16646	0.18071	6.92626	7.05807	6.83236	7.48002	7.46659	7.41832
Maize	leaf length	4.87495	4.85946	4.76412	5.25770	5.27452	5.08765	0.59814	0.60920	0.61436	0.51469														

Supplemental Table 8. Result of E6.1, E8.1 to E8.6

Dataset	Trait	RMSE							r							R-squre							MAPE						
		E6.1	E8.1	E8.2	E8.3	E8.4	E8.5	E8.6	E6.1	E8.1	E8.2	E8.3	E8.4	E8.5	E8.6	E6.1	E8.1	E8.2	E8.3	E8.4	E8.5	E8.6	E6.1	E8.1	E8.2	E8.3	E8.4	E8.5	E8.6
Soybean	of bloomin	9.10924	8.84830	9.27079	8.93285	8.84830	8.85772	8.84830	0.84909	0.85850	0.84373	0.85708	0.85850	0.85780	0.85850	0.71866	0.73467	0.70881	0.73030	0.73467	0.73396	0.73467	10.88687	10.35980	10.66030	10.35502	10.35980	10.41975	10.35980
Cotton	elongation	0.65940	0.65660	0.66173	0.65660	0.65660	0.65660	0.65660	0.72380	0.72515	0.72266	0.72515	0.72515	0.72515	0.72515	0.51412	0.51766	0.51039	0.51766	0.51766	0.51766	0.51766	2.54953	2.52732	2.54643	2.52732	2.52732	2.52732	2.52732
Cotton	er length (n	0.94267	0.94138	0.96541	0.94138	0.94075	0.94358	0.94269	0.81492	0.81565	0.80669	0.81565	0.81682	0.81495	0.81541	0.66219	0.66306	0.64500	0.66306	0.66371	0.66171	0.66280	1.52361	1.52166	1.55377	1.52166	1.53289	1.52149	1.53015
Cotton	er microns	0.23709	0.23697	0.24427	0.23697	0.23697	0.23884	0.23860	0.71718	0.71735	0.69804	0.71735	0.71735	0.71136	0.71288	0.50658	0.50729	0.47501	0.50729	0.50729	0.49857	0.50038	1.00033	0.99760	1.02985	0.99760	0.99760	1.01157	0.99930
Cotton	rength (cN	1.02441	1.02338	1.06045	1.02338	1.02338	1.02741	1.02338	0.82008	0.82075	0.80580	0.82075	0.82075	0.81779	0.82075	0.66708	0.66846	0.64305	0.66846	0.66846	0.66408	0.66846	1.77220	1.76721	1.83205	1.76721	1.76721	1.76667	1.76721
Wheat	disease se	25.63371	25.63371	25.93698	25.63371	25.48551	25.62557	25.87641	0.52908	0.52908	0.51813	0.52908	0.53452	0.52569	0.51095	0.27151	0.27151	0.25422	0.27151	0.28064	0.27296	0.25804							
Soybean	acid conte	2.59411	2.57746	2.54454	2.57746	2.57746	2.57746	2.57746	0.64570	0.64883	0.66356	0.64883	0.64883	0.64883	0.64883	0.41655	0.42129	0.43520	0.42129	0.42129	0.42129	0.42129	6.66358	6.70420	6.57775	6.70420	6.70420	6.70420	6.70420
Soybean	acid conte	0.83129	0.82419	0.85772	0.82865	0.82419	0.83448	0.82419	0.79353	0.79685	0.78034	0.79673	0.79685	0.79160	0.79685	0.61298	0.62026	0.58598	0.61594	0.62026	0.61073	0.62026	6.04260	6.00524	6.18863	5.96604	6.00524	6.08479	6.00524
Soybean	acid conte	18.07655	18.07655	18.25174	18.07655	18.10012	18.27471	18.07738	0.67625	0.67625	0.67420	0.67625	0.68230	0.66738	0.68273	0.45113	0.45113	0.44111	0.45113	0.44984	0.43968	0.45112	7.19678	7.19678	7.19420	7.19678	7.18198	7.28738	7.16750
Soybean	seed weigh	2.57773	2.57773	2.59475	2.65857	2.57058	2.59772	2.57773	0.79001	0.79001	0.79077	0.78266	0.79078	0.78533	0.79001	0.61503	0.61503	0.60580	0.59498	0.61502	0.60793	0.61503	10.90752	10.90752	10.72720	10.98436	10.65743	10.94456	10.90752
Soybean	af length (c	1.01217	1.01217	0.99975	1.01217	1.01217	1.01673	1.01370	0.49590	0.49590	0.51123	0.49590	0.49590	0.50658	0.49682	0.24740	0.24740	0.26227	0.24740	0.24740	0.24263	0.24696	4.69885	4.69885	4.61465	4.69881	4.69881	4.68458	4.71443
Soybean	af width (c	0.90483	0.89491	0.87691	0.89491	0.89491	0.89491	0.86997	0.66210	0.67380	0.68028	0.67380	0.67380	0.67380	0.68459	0.43514	0.43862	0.46129	0.43862	0.43862	0.43862	0.47014	6.26506	11.40622	5.88924	11.40622	11.40622	11.40622	5.92432
Maize	anthesis an	0.66482	0.66376	0.66698	0.66047	0.66047	0.66815	0.66820	0.65189	0.65295	0.64548	0.65305	0.65305	0.64530	0.64724	0.41772	0.41947	0.41457	0.42439	0.42439	0.41253	0.41171	7.39528	7.33602	7.46308	7.38128	7.38128	7.35931	7.45951
Maize	ob weight (	3.07653	3.07213	3.09932	3.09097	3.07213	3.11071	3.08166	0.66807	0.66751	0.66196	0.66348	0.66751	0.65865	0.66680	0.44106	0.44290	0.43248	0.43562	0.44290	0.42913	0.43920	9.80062	9.85681	9.83881	9.91297	9.85682	9.91371	9.83761
Maize	to anthesis	1.60867	1.60569	1.61188	1.60572	1.60158	1.61613	1.60615	0.67821	0.68250	0.67981	0.68041	0.68382	0.67335	0.68240	0.45640	0.45739	0.45185	0.45809	0.45933	0.45125	0.45714	1.21420	1.20842	1.21040	1.22119	1.20634	1.22121	1.20521
Maize	to silking	1.76483	1.76483	1.78328	1.77657	1.76483	1.79978	1.76652	0.65841	0.65841	0.64874	0.65469	0.65841	0.63823	0.65750	0.42610	0.42610	0.41496	0.41973	0.42610	0.40281	0.42497	1.31935	1.31935	1.32196	1.32598	1.31935	1.33132	1.32108
Maize	o tasseling	1.90091	1.90091	1.93804	1.91711	1.90094	1.91590	1.90091	0.68935	0.68935	0.67409	0.69022	0.68898	0.68418	0.68935	0.47097	0.47097	0.44887	0.46260	0.47093	0.46341	0.47097	1.59571	1.59571	1.63345	1.61137	1.59547	1.60051	1.59571
Maize	diameter (	0.19984	0.19984	0.20188	0.20093	0.19984	0.19980	0.19984	0.59238	0.59238	0.58162	0.58623	0.59238	0.59468	0.59238	0.34602	0.34602	0.33313	0.33923	0.34602	0.34672	0.34602	8.74569	8.74569	8.74361	8.74760	8.74569	8.74341	8.74569

Supplemental Table 9. Impact of population size																				
Dataset	Trait	RMSE				r				R-squre				MAPE						
		TSN=150	TSN=300	TSN=600	TSN=134	TSN=150	TSN=300	TSN=600	TSN=134	TSN=150	TSN=300	TSN=600	TSN=134	TSN=150	TSN=300	TSN=600	TSN=1345			
Rice	Flag leaf length (cm)	5.302	5.001	4.779	4.588	0.619	0.675	0.707	0.736	0.38	0.449	0.496	0.536	9.431	8.872	8.435	8.043			
Rice	Flag leaf width (cm)	0.354	0.343	0.336	0.327	0.458	0.51	0.542	0.603	0.224	0.284	0.317	0.369	2.14	2.058	1.853	1.951			
Rice	Grain length (mm)	0.322	0.3	0.287	0.264	0.893	0.908	0.915	0.928	0.791	0.821	0.835	0.859	1.063	0.983	0.92	0.83			
Rice	Grain number per panicle	31.685	29.953	29.007	27.19	0.383	0.489	0.534	0.612	0.144	0.234	0.281	0.365	13.373	12.607	12.291	11.34			
Rice	Height (cm)	7.538	7.023	6.35	5.863	0.683	0.733	0.791	0.825	0.464	0.535	0.619	0.676	4.524	4.18	3.762	3.435			
Rice	Grain weight (g)	1.975	1.777	1.632	1.425	0.793	0.837	0.865	0.899	0.623	0.695	0.743	0.804	4.233	3.763	3.432	2.94			
Rice	Grain width (mm)	0.108	0.094	0.085	0.08	0.861	0.894	0.914	0.926	0.738	0.798	0.833	0.855	0.531	0.468	0.421	0.381			

Supplemental Table 10. Execution device and hyperparameters documentation

	Trait	MLP					SVR					RF					CNN					LSTM					TE					Meta model					
		Device	Learning r	Batch size	Dropout	Patience	Device	Kernel	C	Epsilon	Gamma	Device	N_estimat	Min_sam	Min_sam	Max_dept	Max_featu	Device	Learning r	Batch size	Dropout	Patience	Device	Learning r	Batch size	Dropout	Patience	Device	Learning r	Batch size	Dropout	Patience	Device	Learning r	Batch size	Dropout	Patience
Main setting		NVIDIA C	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150	NVIDIA C	0.001	64	0.5	600	Apple M1	0.001	64	0	190
E1.1	Wheat_RI	NVIDIA C	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	Nonsupport					Apple M1	0.001	64	0	190					
E1.2	Wheat_RI	13th Gen	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150	NVIDIA C	0.001	64	0.5	600	Apple M1	0.001	64	0	190
E1.3	Wheat_RI	Base on E1.1 to E1.2																											Apple M1	0.001	64	0	190				
E2.1 - E2.3	Rice_H,	13th Gen	0.001	64	0.5	150																									Apple M1	0.001	64	0	190		
E2.1 - E2.3	Except Ri	NVIDIA C	0.001	64	0.5	150																									Apple M1	0.001	64	0	190		
E3.1 - E3.5	Rice_H,	13th Gen	0.001	64	0.5	150																									Apple M1	0.001	64	0	190		
E3.1 - E3.5	Except Ri	NVIDIA C	0.001	64	0.5	150																									Apple M1	0.001	64	0	190		
E4.1 - E4.9	Rice_H,	13th Gen	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150				Apple M1	0.001	64	0	190		
E4.1 - E4.9	Except Ri	NVIDIA C	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150				Apple M1	0.001	64	0	190		
E5.1 - E5.10	Rice_H,	13th Gen	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150				Apple M1	0.001	64	0	190		
E5.1 - E5.10	Except Ri	NVIDIA C	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150				Apple M1	0.001	64	0	190		
E6.1	Rice_H,	13th Gen	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150				Apple M1	0.001	64	0	190		
E6.1	Except Ri	NVIDIA C	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150				Apple M1	0.001	64	0	190		
E7.1 - E7.3	Rice_H,	13th Gen	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None																				
E7.1 - E7.3	Except Ri	NVIDIA C	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None																				
E7.4	Maize KWPE																	NVIDIA C	0.008	15	0.5	200															
E7.4	Maize KNPE																	NVIDIA C	0.01	22	0.3	200															
E7.4	Maize PH																	NVIDIA C	0.004	25	0.5	200															
E7.4	Maize DTA																	NVIDIA C	0.001	44	0.3	200															
E7.4	Except Maize KWPE, KNPE, PH, DTA																	NVIDIA C	0.001	64	0.5	200															
E7.5 - E7.6	All																						NVIDIA C	0.001	64	0.5	150	NVIDIA C	0.001	64	0.5	600					
E8.1	Rice_H,	13th Gen	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150	NVIDIA C	0.001	64	0.5	600	Apple M1	0.001	64	0	190
E8.1	Except Ri	NVIDIA C	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150	NVIDIA C	0.001	64	0.5	600	Apple M1	0.001	64	0	190
E8.2 - E8.6	Rice_H,	13th Gen	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150	NVIDIA C	0.001	64	0.5	600	NVIDIA C	0.001	64	0	190
E8.2 - E8.6	Except Ri	NVIDIA C	0.001	64	0.5	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.001	64	0.5	200	NVIDIA C	0.001	64	0.5	150	NVIDIA C	0.001	64	0.5	600	NVIDIA C	0.001	64	0	190
Fine-tuning the hy	SRDS	13th Gen	0.001	256	0.7	150	13th Gen	rbf	10	0.1	scale	13th Gen	300	2	2	None	None	NVIDIA C	0.0001	16	0.3	200	NVIDIA C	0.001	64	0.7	150	NVIDIA C	0.001	128	0.3	600	13th Gen	0.0001	16	0.3	190