Supplementary Material

Content

Tab1e S1. Decisive variety *x* and linear coded data of the Anshun Pan experiment.

Variable (X_i)	Changes in pitch	Design level®				
		-2	-1	0	1	2
Density (X_1)	6,000 (plants/hm^2)	42,000	48,000	54,000	60,000	66,000
N (X_2)	52.5 (kg/hm^2)	69	121.5	174	226.5	279
P_2O_5 (X_3)	37.5 (kg/hm^2)	75	112.5	150	187.5	225
K_2O (X_4)	45 (kg/hm^2)	75	120	165	210	255

Table S2. Experiment structural matrix of the Anshun Pan experiment.

Group code	x_1	x_2	x_3	x_4	Production (kg/hm^2)
1	1	1	1	1	10,120.5
2	1	1	1	-1	10,480.5
3	1	1	-1	1	10,705.5
4	1	1	-1	-1	10,153.5
5	1	-1	1	1	10,212.0
6	1	-1	1	-1	10,315.5
7	1	-1	-1	1	10,932.0
8	1	-1	-1	-1	9,205.5
9	-1	1	1	1	10,123.5
10	-1	1	1	-1	10,051.5
11	-1	1	-1	1	10,365.0
12	-1	1	-1	-1	10,534.5
13	-1	-1	1	1	10,603.5
14	-1	-1	1	-1	10,095.0
15	-1	-1	-1	1	10,500.0
16	-1	-1	-1	-1	8,925.0
17	-2	0	0	0	9,589.5
18	2	0	0	0	10,407.0
19	0	-2	0	0	10,732.5
20	0	2	0	0	10,015.5
21	0	0	-2	0	9,606.0

22	0	0	2	0	10,233.0
23	0	0	0	-2	10,237.5
24	0	0	0	2	10,017.0
25	0	0	0	0	10,228.5
26	0	0	0	0	11,020.5
27	0	0	0	0	11,112.0
28	0	0	0	0	11,421.0
29	0	0	0	0	11,365.5
30	0	0	0	0	11,248.5
31	0	0	0	0	10,905.0
32	0	0	0	0	11,167.5
33	0	0	0	0	11,269.5
34	0	0	0	0	11,227.5
35	0	0	0	0	11,943.0
36	0	0	0	0	11,905.5

Tab1e S3. Decisive variety *x* and linear coded data of the Anshun Tang experiment.

Variable (X_i)	**Changes in pitch**	**Design level®**				
		-2	-1	0	1	2
Density (X_1)	5,340 (plants /hm^2)	53,355	58,695	64,035	69,360	74,700
N (X_2)	180 (kg/hm^2)	0	180	360	540	720
P_2O_5 (X_3)	120 (kg/hm^2)	0	120	240	360	480
K_2O (X_4)	120 (kg/hm^2)	0	120	240	360	480

Table S4. Experiment structural matrix of the Anshun Tang experiment

Group code	x_1	x_2	x_3	x_4	**Production (kg/hm^2)**
1	1	1	1	1	11,288.40
2	1	1	1	-1	11,719.35
3	1	1	-1	1	11,993.55
4	1	1	-1	-1	10,898.40
5	1	-1	1	1	11,843.25

6	1	-1	1	-1	11,517.00
7	1	-1	-1	1	12,269.40
8	1	-1	-1	-1	10,163.85
9	-1	1	1	1	11,284.05
10	-1	1	1	-1	11,195.85
11	-1	1	-1	1	11,577.75
12	-1	1	-1	-1	11,785.05
13	-1	-1	1	1	11,868.60
14	-1	-1	1	-1	11,247.90
15	-1	-1	-1	1	12,471.60
16	-1	-1	-1	-1	10,885.35
17	-2	0	0	0	11,628.30
18	2	0	0	0	10,631.70
19	0	-2	0	0	12,025.50
20	0	2	0	0	11,152.20
21	0	0	-2	0	10,653.00
22	0	0	2	0	10,812.45
23	0	0	0	-2	11,423.10
24	0	0	0	2	11,152.80
25	0	0	0	0	13,428.00
26	0	0	0	0	11,721.30
27	0	0	0	0	12,489.45
28	0	0	0	0	12,864.90
29	0	0	0	0	12,797.25
30	0	0	0	0	12,655.20
31	0	0	0	0	12,237.00
32	0	0	0	0	12,555.90
33	0	0	0	0	12,681.60
34	0	0	0	0	12,630.30
35	0	0	0	0	13,502.10
36	0	0	0	0	13,456.65

Table S5. Decisive variety *x* and linear coded data of the Chifeng Zheng experiment.

Variable (X_i)	Changes in pitch	Design level ®				
		-2	-1	0	1	2
Density (X_1)	0.75 (10,000 plants/hm^2)	5.25	6	6.75	7.5	8.25
N (X_2)	75 (kg/hm^2)	450	525	600	675	750
P_2O_5 (X_3)	75 (kg/hm^2)	75	150	225	300	375
K_2O (X_4)	37.5 (kg/hm^2)	75	112.5	150	187.5	255

Table S6. Experiment structural matrix of the Chifeng Zheng experiment.

Group code	x_1	x_2	x_3	x_4	Production (kg/hm^2)
1	1	1	1	1	12,696.9
2	1	1	1	-1	12,360
3	1	1	-1	1	12,691.5
4	1	1	-1	-1	13,038
5	1	-1	1	1	13,128
6	1	-1	1	-1	10,619.4
7	1	-1	-1	1	10,121.25
8	1	-1	-1	-1	8,980.95
9	-1	1	1	1	1,1347.35
10	-1	1	1	-1	12,156.75
11	-1	1	-1	1	11,232.9
12	-1	1	-1	-1	13,891.65
13	-1	-1	1	1	12,916.8
14	-1	-1	1	-1	13,147.05
15	-1	-1	-1	1	11,794.05
16	-1	-1	-1	-1	12,329.85
17	2	0	0	0	13,056.15
18	-2	0	0	0	12,371.4

19	0	2	0	0	10,450.2
20	0	-2	0	0	10,670.25
21	0	0	2	0	12,561.75
22	0	0	-2	0	14,222.85
23	0	0	0	2	13,220.1
24	0	0	0	-2	12,652.35
25	0	0	0	0	11,888.1
26	0	0	0	0	11,153.4
27	0	0	0	0	12,295.8
28	0	0	0	0	13,187.4
29	0	0	0	0	12,271.8
30	0	0	0	0	10,712.55
31	0	0	0	0	13,017.9

Table S7. Yield and efficiency values of various cultivation measures in the Anshun Pan experiment. The yield data of three independent experiments were processed by min-max normalization.

Group Code	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Production	0.396	0.515	0.590	0.407	0.426	0.461	0.665	0.093	0.397	0.373	0.477	0.533
CCR **efficiency value**	0.751	0.853	0.897	0.964	0.811	0.984	1.000	1.000	0.924	0.954	0.984	1.000
GDM-DEA efficiency value	0.695	0.783	0.854	0.893	0.765	0.847	0.965	0.906	0.737	0.801	0.885	1.081
Group Code	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Production	0.556	0.388	0.522	0.000	0.220	0.491	0.599	0.361	0.226	0.433	0.435	0.362
CCR **efficiency value**	1.000	1.000	1.000	0.983	1.000	0.838	1.000	0.833	1.000	0.857	1.000	0.835
GDM-DEA efficiency value	0.847	0.890	1.082	0.957	0.863	0.815	1.020	0.761	0.968	0.733	0.951	0.764
Group Code	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
Production	0.432	0.694	0.725	0.827	0.809	0.770	0.656	0.743	0.777	0.763	1.000	0.988
CCR **efficiency value**	0.856	0.923	0.930	0.956	0.952	0.942	0.913	0.935	0.944	0.940	1.000	0.997
GDM-DEA efficiency value	0.856	0.923	0.930	0.956	0.952	0.942	0.913	0.935	0.944	0.940	1.003	0.997

Table S8. Yield and efficiency values of various cultivation measures in theAnshun Tang experiment. The yield data of three independent experiments were processed by min-max normalization.

Group Code	1	2	3	4	5	6	7	8	9	10	11	12
Production	0.337	0.466	0.548	0.220	0.503	0.405	0.631	0.000	0.336	0.309	0.424	0.486
CCR **efficiency value**	0.768	0.865	0.962	0.925	0.838	1.000	0.984	0.934	0.905	0.950	0.928	1.000
GDM-DEA efficiency value	0.768	0.807	0.816	0.750	0.806	0.793	0.835	0.700	0.905	0.910	0.928	0.958
Group Code	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Production	0.511	0.325	0.691	0.216	0.439	0.140	0.558	0.296	0.147	0.194	0.377	0.296
CCR **efficiency value**	0.952	1.000	1.000	1.000	0.776	0.943	0.891	1.000	0.789	0.801	0.840	1.000
GDM-DEA efficiency value	0.952	0.914	1.008	0.884	0.750	0.943	0.891	0.826	0.789	0.801	0.836	0.836
Group Code	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
Production	0.978	0.467	0.697	0.809	0.789	0.746	0.621	0.717	0.754	0.739	1.000	0.986
CCR **efficiency value**	0.995	0.868	0.925	0.953	0.948	0.937	0.906	0.930	0.939	0.935	1.000	0.997
GDM-DEA efficiency value	0.995	0.868	0.925	0.953	0.948	0.937	0.906	0.930	0.939	0.935	1.003	0.997

Table S9. Yield and efficiency values of various cultivation measures in the Chifeng Zheng experiment.

Group Code	1	2	3	4	5	6	7	8	9	10	11
Production	0.709	0.645	0.708	0.774	0.791	0.313	0.218	0.000	0.451	0.606	0.430
CCR **efficiency value**	0.744	0.847	0.788	0.939	0.959	0.808	0.813	0.728	0.726	0.875	0.809
GDM-DEA efficiency value	0.744	0.829	0.770	0.911	0.858	0.808	0.688	0.715	0.665	0.816	0.682
Group Code	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Production	0.937	0.751	0.795	0.537	0.639	0.777	0.647	0.280	0.322	0.683	1.000
CCR **efficiency value**	1.000	0.982	1.000	0.957	1.000	0.881	1.000	0.663	1.000	0.816	1.000
GDM-DEA efficiency value	0.970	0.844	1.027	0.801	0.982	0.881	0.835	0.605	0.817	0.816	1.199
Group Code	23	24	25	26	27	28	29	30	31		
Production	0.809	0.700	0.555	0.414	0.632	0.802	0.628	0.330	0.770		
CCR **efficiency value**	0.855	1.000	0.803	0.753	0.830	0.890	0.828	0.723	0.879		

GDM-DEA efficiency value 0.779 1.030 0.803 0.753 0.830 0.890 0.828 0.723 0.879

*The yield data of three independent experiments were processed by min-max normalization.

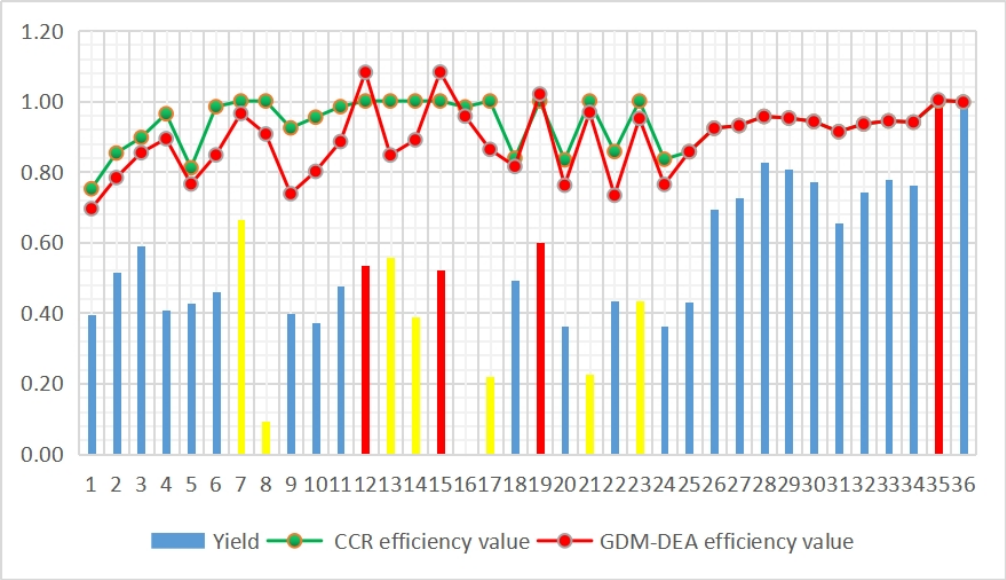

Figure S1. Output and efficiency of the Anshun Pan experiment. The red column bar represents the yield corresponding to the cultivation measures with *CCR* and GDM-DEA effective, while the yellow column bar represents the yield corresponding to the cultivation measures with *CCR* effective only. The green broken line indicates the efficiency trend of GDM-DEA, and each broken point represents the efficiency value of GDM-DEA. The red broken line represents the efficiency trend of *CCR*, and each broken point represents the *CCR* efficiency value.

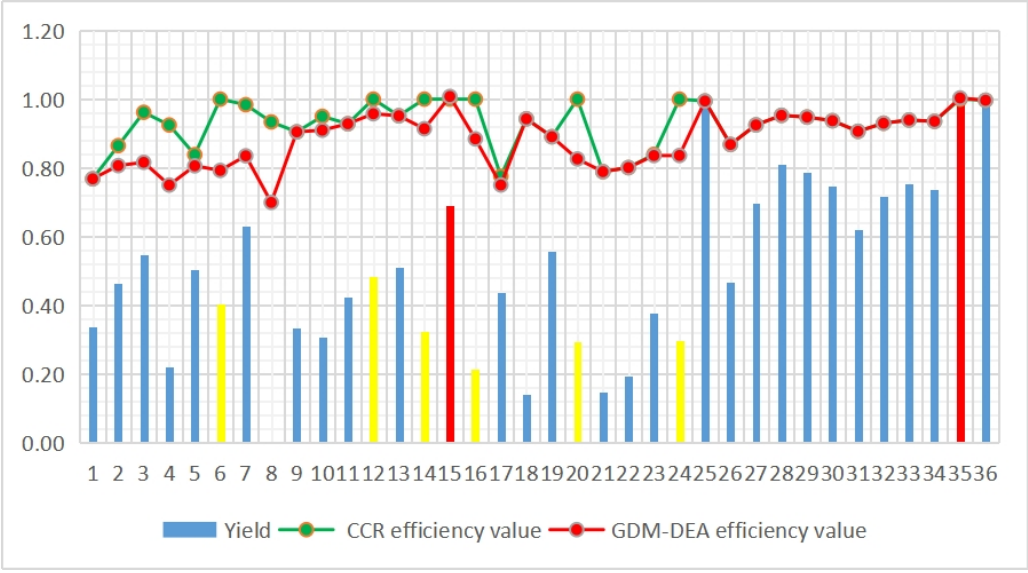

Figure S2. Output and efficiency of the Anshun Tang experiment. The red column bar represents the

yield corresponding to the cultivation measures with *CCR* and GDM-DEA effective, while the yellow column bar represents the yield corresponding to the cultivation measures with *CCR* effective only. The red broken line indicates the efficiency trend of GDM-DEA, and each broken point represents the efficiency value of GDM-DEA. The green broken line represents the efficiency trend of *CCR*, and each broken point represents the *CCR* efficiency value.

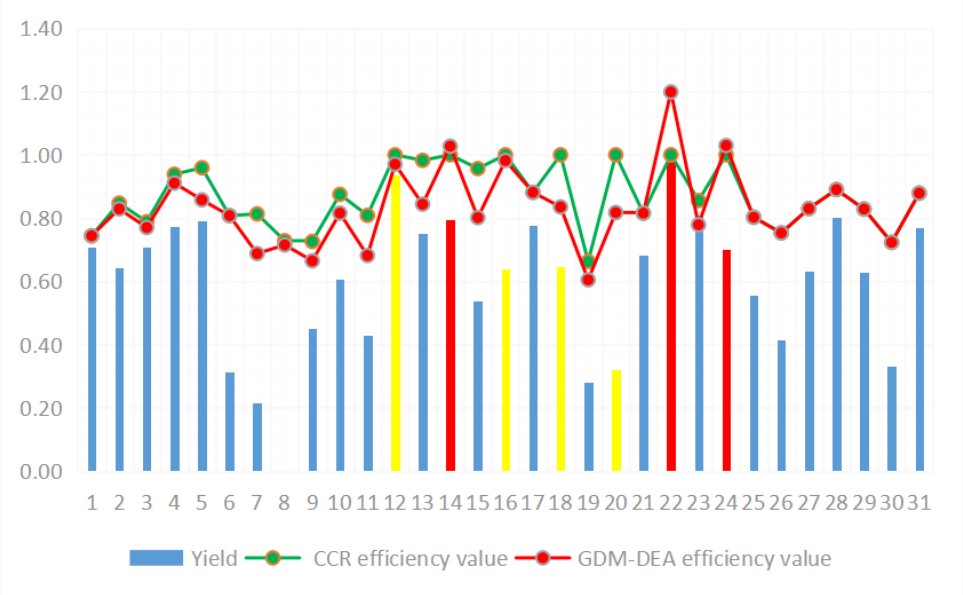

Figure S3. Output and efficiency of the Chifeng Zheng experiment. The red column bar represents the yield corresponding to the cultivation measures with *CCR* and GDM-DEA effective, while the yellow column bar represents the yield corresponding to the cultivation measures with *CCR* effective only. The red broken line indicates the efficiency trend of GDM-DEA, and each broken point represents the efficiency value of GDM-DEA. The green broken line represents the efficiency trend of *CCR*, and each broken point represents the *CCR* efficiency value.