International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; SP-9(1): 196-200

Received: 10-10-2020
Accepted: 16-12-2020

Technological refinement to enhance profitability in hybrid rice seed production

RDS Yadav, Ajay Kumar, RK Singh, Purushottam and Vineet Dheer

DOI: https://doi.org/10.22271/chemi.2021.v9.i1d.11569

Abstract

Rice is livelihood of majority of population in tropical and sub-tropical parts of the world. Hybrid rice varieties have been witnessed to enhance the production as well productivity over the open pollinated varieties and that's why Indian farmers are being given preference the hybrid culture in their rice farming. If the farmers are well trained for the hybrid seed production, their income will certainly be enhanced. Keeping above facts, a series of experiments were conducted with rice hybrid NDRH2 accommodating its parental lines *viz.*, IR58025A, IR58025B, NDR3026-3-1, along with a combination of treatments involving staggered seeding, proper application of GA_3, DAP and Boric Acid, supplementary pollination, etc. measures in order to maximize the hybrid seed production. The economics of various components *viz.*, common cost, treatment cost, cost of cultivation, gross return, net return and benefit cost (B: C) ratio of different treatments were worked out on the basis of input-output analysis. The maximum benefit: cost ratio *viz.*, 2.56:1 and 2.60:1 during 2015 and 2017, respectively was observed with foliar application of GA3 @ 90g/ha+ DAP @ 3%+Boric acid @ 0.3% by producing hybrid seed of rice hybrid NDRH2 using CMS and fertility restorer system at 2:12 male and female planting ratio during *Kharif* season. Thus, these fine tuning in hybrid rice seed production technology advocated as a major profit earning enterprise which needs to be disseminated at farmer's fields also on a mission mode in order to enhance and or double their income by 2022.

Keywords: Hybrid rice, NDRH2, profitability, quality seed

Introduction

Rice (*Oryza sativa*) is the staple food crop of more than half of the population globally. Global rice consumption is projected to be around 650 million tonnes by 2050 (www.ramsar.org).The world rice production in 2020/2021 has been predicted to reach an all-time high of 508.40 million metric tonnes, 1.5 per cent above the 2019 (fao.org).The maximum rice is being produced by China (148 mt) followed by India (118 mt) and Bangladesh (36 mt). The Population Foundation of India has projected that the country̓s population will be1546 million by the end of 2030, 1695 million by the end 2040 and 1824 million by the end of 2050. It is estimated that the demand for rice will be 121.2 million tonnes by the year 2030,129.6 million tonnes by the year 2040, and 137.3 mt by the year 2050. In order to achieve such target, the productivity of rice has to be brought to the level of 3.30 tonnes /ha. However, due to competition from other crops, demand of land from urbanization and industrialization, vulnerable climate, etc. there may be a decline of rice area by 6-7 million ha by 2050. Further, India is currently exporting about 3.5 million tonnes of basmati rice and 6.9 million tonnes of non- basmati rice per year. Under such scenario, the realistic productivity target would be around 3.9 tonnes/ha. Hybrid rice has been earmarked as a key technology for increasing 25 to 30 per cent higher yield. Thus, hybrid rice is expected to play a quantum jump to overall rice production in the coming decades (Vision 2050, CRRI 2013, PP. 26). However, hybrid rice cultivation is still negligible in India, just around 3 million ha out of the around 44 million ha under rice cultivation (thehindubusineessline.com 2020). The reasons being apart from marketing and quality, etc. concerns, a number of technological intricacies are still there which enabled to the lower hybrid seed production and render its higher cost of production (Yuan, 1977; Virmani and Kumar, 1988; Yadav *et al*., 2002) [8, 5, 7]. It is therefore worth trying to re-tune its seed production technology time to time in order to make the hybrid seed available to growers well in time at an affordable cost. A series of experiments were therefore taken up with rice hybrid NDRH2 by integrating almost well culminated components *viz.*, staggered

RDS Yadav
Seed Technology Section, Department of Genetics and Plant Breeding, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Ajay Kumar
Seed Technology Section, Department of Genetics and Plant Breeding, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

RK Singh
Seed Technology Section, Department of Genetics and Plant Breeding, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Purushottam
Seed Technology Section, Department of Genetics and Plant Breeding, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Vineet Dheer
Department of Agronomy, Chandra Shekhar Azad, University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Corresponding Author:
RDS Yadav
Seed Technology Section, Department of Genetics and Plant Breeding, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

seeding, optimized doses of GA3, DAP, Boric acid, supplementary pollination, etc. in order to re-design the technology not only for getting higher yield but also to make it maximum profitable.

Materials and Methods

The experiments were conducted accommodating the parental lines *viz.*, IR 85025 A, 85025 B and NDR 3026-3-1R of rice bybrid NDRH2 during 2015 and 2017 at Instructional farm of Acharya Narendra Deva University of Agriculture and Technology following recommended as well as standard techno methods which have been described well by Kumar *et al.* (2020 a, b) [2, 3]. The economics of different treatments were worked out on the basis of input-output analysis as given in Table 1.

Table 1: Details of basis/prevailing rates for estimating cost of cultivation of Hybrid Rice for one hectare area during 2015 and 2017

S. No.	Operation	Input	Rate (Rs.)		Cost (Rs./ha)	
			2015	2017	2015	2017
Land preparation						
(a)	Ploughing by M.B plough	1tractor (35 HP) for 4 hrs/time	610/hr	620/hr	2440	2480
(b)	Ploughing by Cultivator	1tractor (35 HP) for 4 hrs-2 times	255/hr	360/ hr[1]	2040	2080
(c)	Puddling (2 nos)	1tractor (35 HP) for 3 hrs-2 times	310/hr	325/ hr[1]	1860	1950
(d)	Irrigation	1 Irrigation/1L (1 man/irrigation)	120/hr /240/man/day	125/hr/240/man/day	1200	1240
(e)	Layout	6/men a day	240/man/day	240/man/day	1440	1440
	Total				8980	9190
Fertilizers (150N-75P-50K kg/ha)						
(a)	Urea	265.43 kg	5.92/ kg	6.14/ kg	1571.35	1629.74
(b)	DAP	163.04kg	25/ kg	22./ kg	4076.00	3668.40
(c)	MOP	83.33 kg	16.40/ kg	16.40/ kg	1366.61	1366.61
	Manure	10 ton	1.5/ kg	1.62/ kg	15000	16200
(d)	Fertilizer application	10 men a day	240/ man/ day	240/ man/ day	2400	2400
	Total				24413.96	25264.75
Cost of seed and sowing						
(a)	11.79kg/ ha		460/ kg	92/ kg	4231.08	4231.08
(b)	**Seed treatment (Thirum @2 g/kg seed)**				74.114	78.61
(c)	Nursery management				3560	4240
(d)	Cost of sowing		18 men a day	240/ man/day	4320	4320
	Total				16505.19	17189.69
	Irrigation	4 Irrigation/2L (1 man/irrigation)	120/hr/240/man	125/hr/240/man	4800	2960
	Intercultural operation	20 men a day-2 times	240/man/day	240/man/day	9600	9600
GA3 (g/ha)						
(a)	60	1 labour for application- 4 times	186.59/g (100/L)	186/g (142/L)	11435.40	11435.40
(b)	90	1 labour for application- 4 times	186.59/g (100/L)	187/g (142/ L)	17033.10	17033.10
(c)	120	1 labour for application- 4 times	186.59/g (100/L)	188/g (142/ L)	22630.80	22630.80
	Total				51099.30	51099.30
DAP (%)						
(a)	1	1 labour for application- 4 times	25/kg (100/L)	22/kg (142/L)	240.25	240.02
(b)	2	1 labour for application- 4 times	25/kg (100/L)	22.5 kg (142/L)	240.50	240.45
(c)	3	1 labour for application- 4 times	25/kg (100/L)	22.5/kg (142/L)	240.75	240.68
	Total				721.50	721.15
Boric acid (%)						
(a)	0.1	1 labour for application- 4 times	1.12/g (100/L)	1.12/g (142/L)	241.12	243.12
(b)	0.2	1 labour for application- 4 times	1.12/g (100/L)	1.12/g (142/L)	242.24	244.24
(c)	0.3	1 labour for application- 4 times	1.12/g (100/L)	1.12/g (142/L)	243.36	245.36
	Total				726.72	732.72
Harvesting, package and storage						
(a)	Harvesting and lifting	15 men a day	240/man/day	240/man/day	3600	3600
(b)	Threshing and winnowing	1tractor (35 HP) for 8 hrs- 1 times + 6 men a day	355/hr + 240/man/day	365/hr + 240/man/day	4280	4360
(c)	Package and storage	5 men a day	240/man/day	240/man/day	3200	3200
	Total				11080.00	11160.00
	Land rent	6 month	2400/ha/year	2400/ha/year	1200.00	1200.00
	Miscellaneous charges and depreciation				2545.00	2555.00
	Total A (1 to 7 items)				79124.15	79119.44
	Interest on working capital		12%/annum	12%/annum	4483.42	4483.1376
	Total (Total A + 8)				83607.57	83602.58

Results and Discussion

Various components *viz.*, common cost, treatment cost, cost of cultivation, gross return, net return and benefit: cost ratio of economics are presented in Tables 2 and 3. The common cost was recorded as Rs.83607.57/ha and Rs. 83602.58/ha during 2015 and 2017, respectively. The treatment cost was nil in the control but it was increased as doses of treatments and their combination were increased. The treatment cost was ranged from Rs.240.25/ha to Rs.23114.91/ha and from Rs.240.02/ha to Rs. 23116.84/ha during 2018 and 2017, respectively. Similarly, the total cost incurred was ranged from Rs.83847.82/ha to Rs.106722.48/ ha and from Rs.83842.60/ha to Rs.106719.42/ ha during 2015 and 2017, respectively. The highest cost of cultivation was observed with the treatment combination of GA3 @ 120g/ha + DAP @ 3% + Boric acid @ 0.3% during both the year.

The maximum gross income Rs.376755.26 /ha and Rs.382152.78/ha as well as net return Rs.270034.15/ha and Rs.275434.72/ha during 2015 and 2017, respectively were obtained with the foliar application of GA3@120g/ha+DAP@2%+Boric acid@0.2%. However, the maximum benefit: cost ratio *viz*., 2.56:1 and 2.60:1 during 2015 and 2017, respectively was observed with foliar application of GA3 @ 90g/ha+ DAP @ 3%+Boric acid @ 0.3%. Thus, hybrid rice seed production appeared as a major profit earning enterprise. It is clearly elucidated that among the treatment cost, the GA_3 became an expensive chemical. In fact, the role of GA_3 particularly cell elongation here in hybrid rice the promoting better expression of characters favoring better seed set in the female CMS line cannot be ignored (Kumar *et al*., 2020; Mao *et al*., 1988: Virmani and Kumar, 2004; Yadav *et al*., 2002) [3, 4, 5, 7]. Nevertheless, it is worthwhile to explore the ways to bring down the cost of seed production in totality. Thus, the determination of its optimum dose of application and substituting its application wholly or partly with other available cost effective chemicals can help to growers/ farmers to increase the profitability while producing hybrid rice seed. The present investigation revealed that the application of GA3@120g/ha alone and in combination doses of other treatments can be substituted by the foliar application of GA3@90g/ha +DAP@3%+Boric acid@0.3% in order to catch the highest benefit-cost ratio in comparison to other doses of the treatments, alone or in combinations.

Table 2: Common cost, treatment cost and total cost of hybrid seed in rice hybrid NDRH2 during *Kharif* 2015 and 2027

S. No.	Treatment combination	Common cost (Rs./ha)		Treatment cost (Rs./ha)		Total cost (Rs./ha)		Seed yield (q/ha)	
		2015	2017	2015	2017	2015	2017	2015	2017
1	GA0BA0DAP0	83607.57	83602.58	0.00	0.00	83607.57	83602.58	8.12	8.30
2	GA0BA0DAP1	83607.57	83602.58	240.25	240.02	83847.82	83842.60	8.16	8.41
3	GA0BA0DAP2	83607.57	83602.58	240.50	240.45	83848.07	83843.03	8.28	8.50
4	GA0BA0DAP3	83607.57	83602.58	240.75	240.68	83848.32	83843.26	8.45	8.59
5	GA0BA1DAP0	83607.57	83602.58	241.12	243.12	83848.69	83845.70	8.56	8.73
6	GA0BA1DAP1	83607.57	83602.58	481.37	483.14	84088.94	84085.72	9.59	9.82
7	GA0BA1DAP2	83607.57	83602.58	481.62	483.57	84089.19	84086.15	9.83	10.00
8	GA0BA1DAP3	83607.57	83602.58	481.87	483.80	84089.44	84086.38	10.21	10.44
9	GA0BA2DAP0	83607.57	83602.58	242.24	244.24	83849.81	83846.82	9.07	9.24
10	GA0BA2DAP1	83607.57	83602.58	482.49	484.26	84090.06	84086.84	9.72	9.91
11	GA0BA2DAP2	83607.57	83602.58	482.74	484.69	84090.31	84087.27	9.92	10.13
12	GA0BA2DAP3	83607.57	83602.58	482.99	484.92	84090.56	84087.50	10.32	10.55
13	GA0BA3DAP0	83607.57	83602.58	243.36	245.36	83850.93	83847.94	9.34	9.51
14	GA0BA3DAP1	83607.57	83602.58	483.61	485.38	84091.18	84087.96	9.78	9.97
15	GA0BA3DAP2	83607.57	83602.58	483.86	485.81	84091.43	84088.39	10.05	10.22
16	GA0BA3DAP3	83607.57	83602.58	484.11	486.04	84091.68	84088.62	10.45	10.64
17	GA1BA0DAP0	83607.57	83602.58	11435.40	11435.40	95042.97	95037.98	13.76	13.93
18	GA1BA0DAP1	83607.57	83602.58	11675.65	11675.42	95283.22	95278.00	13.89	14.06
19	GA1BA0DAP2	83607.57	83602.58	11675.90	11675.85	95283.47	95278.43	14.08	14.29
20	GA1BA0DAP3	83607.57	83602.58	11676.15	11676.08	95283.72	95278.66	14.22	14.39
21	GA1BA1DAP0	83607.57	83602.58	11676.52	11678.52	95284.09	95281.10	14.14	14.33
22	GA1BA1DAP1	83607.57	83602.58	11916.77	11918.54	95524.34	95521.12	14.49	14.66
23	GA1BA1DAP2	83607.57	83602.58	11917.02	11918.97	95524.59	95521.55	15.74	15.91
24	GA1BA1DAP3	83607.57	83602.58	11917.27	11919.20	95524.84	95521.78	16.14	16.37
25	GA1BA2DAP0	83607.57	83602.58	11677.64	11679.64	95285.21	95282.22	14.27	14.45
26	GA1BA2DAP1	83607.57	83602.58	11917.89	11919.66	95525.46	95522.24	14.68	14.85
27	GA1BA2DAP2	83607.57	83602.58	11918.14	11920.09	95525.71	95522.67	15.86	16.07
28	GA1BA2DAP3	83607.57	83602.58	11918.39	11920.32	95525.96	95522.90	16.28	16.49
29	GA1BA3DAP0	83607.57	83602.58	11678.76	11680.76	95286.33	95283.34	14.42	14.59
30	GA1BA3DAP1	83607.57	83602.58	11919.01	11920.78	95526.58	95523.36	14.82	15.03
31	GA1BA3DAP2	83607.57	83602.58	11919.26	11921.21	95526.83	95523.79	16.02	16.19
32	GA1BA3DAP3	83607.57	83602.58	11919.51	11921.44	95527.08	95524.02	16.44	16.59
33	GA2BA0DAP0	83607.57	83602.58	17033.10	17033.10	100640.67	100635.68	18.34	18.51
34	GA2BA0DAP1	83607.57	83602.58	17273.35	17273.12	100880.92	100875.70	18.42	18.63
35	GA2BA0DAP2	83607.57	83602.58	17273.60	17273.55	100881.17	100876.13	18.54	18.71
36	GA2BA0DAP3	83607.57	83602.58	17273.85	17273.78	100881.42	100876.36	18.65	18.84
37	GA2BA1DAP0	83607.57	83602.58	17274.22	17276.22	100881.79	100878.80	18.77	18.93
38	GA2BA1DAP1	83607.57	83602.58	17514.47	17516.24	101122.04	101118.82	20.92	21.11
39	GA2BA1DAP2	83607.57	83602.58	17514.72	17516.67	101122.29	101119.25	21.25	21.43
40	GA2BA1DAP3	83607.57	83602.58	17514.97	17516.90	101122.54	101119.48	21.76	21.93
41	GA2BA2DAP0	83607.57	83602.58	17275.34	17277.34	100882.91	100879.92	18.85	19.02
42	GA2BA2DAP1	83607.57	83602.58	17515.59	17517.36	101123.16	101119.94	21.04	21.23
43	GA2BA2DAP2	83607.57	83602.58	17515.84	17517.79	101123.41	101120.37	21.15	21.34
44	GA2BA2DAP3	83607.57	83602.58	17516.09	17518.02	101123.66	101120.60	21.85	22.02
45	GA2BA3DAP0	83607.57	83602.58	17276.46	17278.46	100884.03	100881.04	18.88	19.07
46	GA2BA3DAP1	83607.57	83602.58	17516.71	17763.84	101124.28	101366.42	21.15	21.36
47	GA2BA3DAP2	83607.57	83602.58	17516.96	17764.50	101124.53	101367.08	21.38	21.55

48	GA2BA3DAP3	83607.57	83602.58	17517.21	17519.14	101124.78	101121.72	22.14	22.37
49	GA3BA0DAP0	83607.57	83602.58	22630.80	22630.80	106238.37	106233.38	18.54	18.75
50	GA3BA0DAP1	83607.57	83602.58	22871.05	22870.82	106478.62	106473.40	18.60	18.78
51	GA3BA0DAP2	83607.57	83602.58	22871.30	22871.25	106478.87	106473.83	18.84	19.03
52	GA3BA0DAP3	83607.57	83602.58	22871.55	22871.48	106479.12	106474.06	19.20	19.38
53	GA3BA1DAP0	83607.57	83602.58	22871.92	22873.92	106479.49	106476.50	19.73	19.90
54	GA3BA1DAP1	83607.57	83602.58	23112.17	23113.94	106719.74	106716.52	21.24	21.40
55	GA3BA1DAP2	83607.57	83602.58	23112.42	23114.37	106719.99	106716.95	23.05	23.46
56	GA3BA1DAP3	83607.57	83602.58	23112.67	23114.60	106720.24	106717.18	23.02	23.21
57	GA3BA2DAP0	83607.57	83602.58	22873.04	22875.04	106480.61	106477.62	19.96	20.13
58	GA3BA2DAP1	83607.57	83602.58	23113.29	23115.06	106720.86	106717.64	21.44	21.67
59	GA3BA2DAP2	83607.57	83602.58	23113.54	23115.49	106721.11	106718.07	23.15	23.48
60	GA3BA2DAP3	83607.57	83602.58	23113.79	23115.72	106721.36	106718.30	23.10	23.28
61	GA3BA3DAP0	83607.57	83602.58	22874.16	22876.16	106481.73	106478.74	20.48	20.70
62	GA3BA3DAP1	83607.57	83602.58	23114.41	23116.18	106721.98	106718.76	22.82	22.98
63	GA3BA3DAP2	83607.57	83602.58	23114.66	23116.61	106722.23	106719.19	22.73	22.96
64	GA3BA3DAP3	83607.57	83602.58	23114.91	23116.84	106722.48	106719.42	22.62	22.83

Table 3: Gross return, net return and benefit cost ratio of hybrid seed in rice hybrid NDRH2 during *Kharif* 2015 and 2027

S. No.	Treatment combination	Straw yield (q/ha)		Gross Return (Rs./ha)		Net return (Rs./ha)		Benefit: Cost rario	
		2015	2017	2015	2017	2015	2017	2015	2017
1	GA0BA0DAP0	35.74	35.92	135304.95	138212.07	51697.37	54609.49	0.62	0.65
2	GA0BA0DAP1	38.36	39.13	136339.70	140455.72	52491.88	56613.12	0.63	0.68
3	GA0BA0DAP2	38.92	39.77	138344.08	141992.15	54496.00	58149.12	0.65	0.69
4	GA0BA0DAP3	40.08	40.91	141238.85	143603.91	57390.53	59760.65	0.68	0.71
5	GA0BA1DAP0	37.75	38.58	142647.79	145492.85	58799.10	61647.15	0.70	0.74
6	GA0BA1DAP1	37.88	38.70	159147.38	162950.93	75058.44	78865.21	0.89	0.94
7	GA0BA1DAP2	37.93	38.78	162994.91	165842.98	78905.72	81756.84	0.94	0.97
8	GA0BA1DAP3	37.97	38.83	169080.94	172890.52	84991.50	88804.14	1.01	1.06
9	GA0BA2DAP0	38.05	38.90	150852.99	153701.06	67003.18	69854.25	0.80	0.83
10	GA0BA2DAP1	38.18	39.01	161272.58	164437.64	77182.52	80350.80	0.92	0.96
11	GA0BA2DAP2	38.48	39.27	164517.78	167996.81	80427.47	83909.54	0.96	1.00
12	GA0BA2DAP3	38.72	39.45	170953.94	174743.93	86863.38	90656.43	1.03	1.08
13	GA0BA3DAP0	38.73	39.60	155275.45	158126.53	71424.51	74278.59	0.85	0.89
14	GA0BA3DAP1	38.95	39.78	162348.60	165513.65	78257.41	81425.70	0.93	0.97
15	GA0BA3DAP2	39.08	39.93	166688.18	169536.25	82596.75	85447.87	0.98	1.02
16	GA0BA3DAP3	39.18	40.01	173103.25	176268.31	89011.57	92179.69	1.06	1.10
17	GA1BA0DAP0	40.10	40.97	226201.87	229052.95	131158.89	134014.97	1.38	1.41
18	GA1BA0DAP1	40.38	41.21	228324.05	231169.11	133040.83	135891.11	1.40	1.43
19	GA1BA0DAP2	40.77	41.58	231422.82	234904.86	136139.34	139626.43	1.43	1.47
20	GA1BA0DAP3	38.68	39.53	233347.92	236195.99	138064.19	140917.33	1.45	1.48
21	GA1BA1DAP0	38.80	39.66	232086.00	235255.57	136801.90	139974.47	1.44	1.47
22	GA1BA1DAP1	38.97	39.78	237711.61	240553.65	142187.27	145032.54	1.49	1.52
23	GA1BA1DAP2	39.30	40.15	257761.33	260609.40	162236.74	165087.85	1.70	1.73
24	GA1BA1DAP3	39.40	40.23	264176.40	267981.45	168651.55	172459.68	1.77	1.81
25	GA1BA2DAP0	39.40	40.25	234256.40	237264.47	138971.18	141982.25	1.46	1.49
26	GA1BA2DAP1	40.25	41.10	240944.47	243792.54	145419.00	148270.30	1.52	1.55
27	GA1BA2DAP2	40.46	41.31	259856.11	263344.18	164330.39	167821.51	1.72	1.76
28	GA1BA2DAP3	41.07	41.90	266668.02	270153.07	171142.05	174630.18	1.79	1.83
29	GA1BA3DAP0	38.23	39.08	236480.11	239328.18	141193.78	144044.85	1.48	1.51
30	GA1BA3DAP1	38.37	39.18	242901.21	246383.25	147374.62	150859.89	1.54	1.58
31	GA1BA3DAP2	38.45	39.30	262113.26	264961.33	166586.43	169437.54	1.74	1.77
32	GA1BA3DAP3	38.45	39.28	268833.26	271358.32	173306.18	175834.30	1.81	1.84
33	GA2BA0DAP0	38.55	39.40	299248.33	302096.40	198607.65	201460.72	1.97	2.00
34	GA2BA0DAP1	38.72	39.51	300553.94	304032.97	199673.02	203157.27	1.98	2.01
35	GA2BA0DAP2	38.87	39.70	302496.54	305341.60	201615.37	204465.47	2.00	2.03
36	GA2BA0DAP3	38.93	39.80	304265.58	307436.67	203384.16	206560.31	2.02	2.05
37	GA2BA1DAP0	39.15	39.88	306218.73	308888.72	205336.94	208009.92	2.04	2.06
38	GA2BA1DAP1	39.04	39.87	340602.16	343767.21	239480.11	242648.40	2.37	2.40
39	GA2BA1DAP2	39.20	40.07	345906.26	348917.35	244783.97	247798.10	2.42	2.45
40	GA2BA1DAP3	39.45	40.20	354103.93	356936.93	252981.39	255817.46	2.50	2.53
41	GA2BA2DAP0	39.34	40.13	307527.36	310366.39	206644.44	209486.47	2.05	2.08
42	GA2BA2DAP1	39.48	40.31	342588.45	345753.51	241465.29	244633.57	2.39	2.42
43	GA2BA2DAP2	39.53	40.40	344355.99	347527.07	243232.57	246406.70	2.41	2.44
44	GA2BA2DAP3	39.78	40.51	355593.65	358423.64	254469.99	257303.04	2.52	2.54
45	GA2BA3DAP0	39.86	40.71	308085.71	311253.78	207201.67	210372.74	2.05	2.09
46	GA2BA3DAP1	39.93	40.82	344416.25	347910.35	243291.97	246543.93	2.41	2.43
47	GA2BA3DAP2	39.49	40.28	348029.96	350868.99	246905.42	249501.91	2.44	2.46

48	GA2BA3DAP3	39.60	40.41	360206.53	364008.57	259081.75	262886.86	2.56	2.60
49	GA3BA0DAP0	39.66	40.53	302615.57	306106.66	196377.20	199873.28	1.85	1.88
50	GA3BA0DAP1	39.88	40.65	303608.72	306604.74	197130.10	200131.34	1.85	1.88
51	GA3BA0DAP2	39.90	40.73	307451.73	310616.79	200972.86	204142.96	1.89	1.92
52	GA3BA0DAP3	39.92	40.77	313214.75	316222.82	206735.62	209748.76	1.94	1.97
53	GA3BA1DAP0	40.40	41.15	321767.07	324600.07	215287.57	218123.57	2.02	2.05
54	GA3BA1DAP1	40.42	41.27	345930.08	348618.15	239210.34	241901.63	2.24	2.27
55	GA3BA1DAP2	40.44	41.27	374893.09	381578.15	268173.10	274861.20	2.51	2.58
56	GA3BA1DAP3	40.70	41.55	374452.27	377620.34	267732.02	270903.16	2.51	2.54
57	GA3BA2DAP0	41.08	41.87	325549.52	328388.55	219068.91	221910.94	2.06	2.08
58	GA3BA2DAP1	41.41	42.20	349279.24	353078.27	242558.38	246360.64	2.27	2.31
59	GA3BA2DAP2	42.18	42.96	376755.26	382152.78	270034.15	275434.72	2.53	2.58
60	GA3BA2DAP3	42.11	42.90	375944.71	378943.74	269223.35	272225.45	2.52	2.55
61	GA3BA3DAP0	41.65	42.48	333955.41	337600.46	227473.67	231121.72	2.14	2.17
62	GA3BA3DAP1	41.29	42.14	371341.16	374029.23	264619.18	267310.48	2.48	2.50
63	GA3BA3DAP2	41.54	42.33	369938.83	373737.86	263216.60	267018.67	2.47	2.50
64	GA3BA3DAP3	40.87	41.74	368077.88	371568.97	261355.40	264849.55	2.45	2.48

Note: GA0= GA_3 0g/ha, GA1= GA_3 60g/ha, GA2= GA_3 90g/ha and GA3= GA_3 120g/ha, DAP0= DAP 0%, DAP1= DAP 1%, DAP2=DAP 2% and DAP3=DAP 3%, BA0= Boric acid 0%, BA1= Boric acid 0.1%, BA2= Boric acid 2% and BA3= Boric acid 3%

Conclusion
Based on the above technological refinement in hybrid rice seed production technology, it is concluded that the most expensive chemical *i e*., GA_3 could not be substituted by the application of the boric Acid and DAP in alone or in combinations completely. But its doses could be lowered by the application of boric acid and DAP in proper combinations. Thus following techno measures *viz*., staggered seeding, planting ratio and direction, supplementary pollination, etc. and with the foliar application of GA3@90g/ha + DAP@3%+Boric acid@0.3%, the profit of hybrid seed of rice hybrid NDRH2 can be harnessed to the extent of 2.60 times.

Acknowledgements
Authors are thankful to the Head, Seed Technology Section and In-charge, Instructional farm of the University for providing the laboratory and field levels facilities, respectively during the course of the study.

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