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Comparative economics of high density planting under Indo-Israel production technology and conventional method of Nagpur mandarin cultivation in Amravati district of Maharashtra

[1]Savita Ramesh Gosal, [2]Dr. VK Khobarkar, [3]Dr. UT Dangore and [4]Dr. SG Bharad

[1]M.Sc. Scholar, Department of Agricultural Economics and Statistics, Dr. P. D. K. V, Akola, Maharashtra, India

[2]Assistant Professor, Department of Agricultural Economics and Statistics, Dr. P. D. K. V, Akola, Maharashtra, India

[3]Assistant Professor, Department of Agricultural Economics and Statistics, Dr. P. D. K. V, Akola, Maharashtra, India

[4]Head, Department of Fruit Science, Dr. P. D. K. V, Akola, Maharashtra, India

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Corresponding Author: Savita Ramesh Gosal

Abstract

Mandarins (*Citrus reticulata Blanco*) are a major fruit in global citrus production, with significant cultivation in India, particularly in the Vidarbha region for the Nagpur Mandarin. Despite its prominence, productivity is constrained by factors such as senile orchards, wide spacing, and suboptimal management. This study evaluates the impact of high-density planting (HDP) under Indo-Israel Production Technology (IIPT) compared to conventional planting methods. HDP involves closer tree spacing to enhance land use efficiency and productivity. The study assesses establishment costs, amortization, and cultivation expenses associated with both methods. Results indicate that HDP requires a higher initial investment (₹510,982.24) compared to conventional planting (₹375,979.24), leading to increased annual amortization costs for HDP (₹17,186.24 per hectare) versus conventional methods (₹14,476.53 per hectare). However, HDP demonstrates greater returns from intercropping (₹47,964.00) compared to conventional methods (₹33,461.00). The analysis shows that while HDP incurs higher costs for grafts, labor, and other inputs, it also offers potential benefits in terms of land utilization and profitability. The choice between HDP and conventional methods should weigh the higher costs against the potential for increased returns and more efficient land use.

Keywords: High-Density Planting (HDP), Indo-Israel Production Technology (IIPT), Nagpur Mandarin

1. Introduction

Mandarins (*Citrus reticulata Blanco*) are easily peelable fruits and segments are conveniently consumed by hands. Among citrus group, mandarins contribute to the second largest production (26%) after sweet oranges (56%) in the world citrus basket. Out of total 12.51 million tonnes of citrus production in India, mandarins constitutes 5.27 million metric tonnes from 0.42 million ha area and ranks the first among the citrus fruits grown in the country. The average national productivity of mandarins in India is 12.54 tonnes ha−1, which is fairly low as compared to many advanced mandarin growing countries. Mandarin cultivation is popular among citrus growers due to its constant demand in the domestic market and easy adaptability to varied agro-climatic conditions. Among mandarins, “Nagpuri” or “Nagpur” mandarin is cherished for its unique thirst quenching sweet and sour taste. The Vidarbha region of Maharashtra (a major pocket of Nagpur mandarin in Maharashtra) and adjoining parts of Madhya Pradesh and Rajasthan (Jhalawar district) have more or less similar agro-climatic conditions and hence cultivation of this mandarin cultivar is blooming and expanding in these areas.

The Amravati and Nagpur districts of Maharashtra contribute about 80% of the total area under mandarin orchards in the state, sharing 48.88% and 31.45% respectively. With regard to the production of mandarin, Amravati district occupies 37.36% while Nagpur occupies 23.87% share in the Vidarbha citrus market. Further, Vidarbha is India’s only citrus-growing region with two fruiting seasons (Ambia and Mrig). The fruit available from September to December is Ambia, which has a slightly sour taste. The sweeter Mrig crop follows this in February. Hence Nagpur mandarin enjoys favorable climatic conditions to provide bulk production twice a year.

1.1 Aspects of High-Density Planting in Nagpur mandarin under Indo-Israel production technology

The low productivity of mandarins in these regions is primarily attributed to senile old orchards, conventional wide spacing (6 × 6 m) and poor orchard management. This scenario demands innovative horticultural practices to get high and early return for investments, particularly in initial years of orchard establishment. Often due to wide spacing and low canopy volume, the spacing of 6 × 6 m fails to harness the available land during the initial phases of orchard development. This has given the thrust to evaluate

the concept of high-density planting (HDP) for increasing the production and returns per unit area. It is the concept of HDP to exploit vertical and horizontal cropping area, to reap maximum profit against invested inputs and natural resources. The HDP only provide initial high production and net returns, especially during first 10–15 years, but also facilitate efficient use of fertilizers, irrigation and other inputs. The main advantages of these intensive systems of cropping are precocity, low cost per unit production, possibility of higher mechanization, automation as in fertigation with higher input use efficiency. In commercial plantations, mostly smaller canopies are obtained either by using dwarfing rootstocks or by training and pruning (canopy management practices).

The global citrus business places great priority on the cultivation of mandarins, which are prized for their flavor, nutritional value, and economic relevance. Traditional farming techniques, however, frequently encounter difficulties like scarce land, labor shortages, and erratic environmental conditions. Indo-Israel Production Technology (IIPT) has surfaced as a viable strategy to improve citrus production efficiency and yield quality in response to these difficulties. High-density planting (HDP), which entails spacing citrus trees closer together than in traditional orchards, is one of the main tenets of IIPT. This method seeks to enhance orchard management procedures, optimize resource allocation, and maximize land utilization. Despite being widely used in many citrus-growing locations, little is known about how HDP specifically affects mandarin agriculture within the IIPT framework.

2. Methodology

The present study was conducted in Amravati district of Vidharbha region Maharashtra. The primary data were collected from selected farmers by survey method with personal interview through a specially designed schedule and pertain to the year 2023-24. The multistage random sampling technique was followed to select (30) HDP and (60) Conventional orchards, with the total of 90 respondents were selected from two villages in each three tahsil of Amravati district namely Achalpur, Morshi, Warud.

Conceptual issues in economic analysis

Even though HDP under Indo-Israel production technology of Nagpur mandarin has been in practice for over many years. It is the system, which only recently, has been garnering attention among farmers across Amravati, At present, the majority of HDP orchards are in the initial establishment phase and, hence economic information of 30 practitioners who have been receiving yield for the last 2 to 3 years or above have been considered for economic analysis while the cost and return information of all 60 conventional practitioners have been considered for economic analysis. Moreover, every cost and return information has been converted to cost and returns ha−1.

2.1 Establishment cost

Every long duration horticultural crop has two phases i.e., establishment phase or development phase and production phase. The Nagpur mandarin orchard starts bearing after five year from the year of plantation. The grower has to invest considerable amount for establishment orchard till it starts bearing. The cost of establishment of Nagpur mandarin can be regarded as an investment capital. In order to study, capital investment made by the farmers of HDP under Indo-Israel production technology and conventional cultivation of Nagpur mandarin in study area, a sample of 25 Mandarin growers was selected from each technology holding the orchard of one year to five year of age i.e. first five year.

The following items include calculating per hectare establishment cost of Nagpur mandarin:

Cost of land preparation, cost of digging and pit filling, cost of graft, cost of planting, cost of manure, cost of fertilizer (N. P. K), cost plant protection, Incidental charges, intercultural operation, repairing charges, working capital, depreciation on implementation and farm building, land revenue, interest on fixed capital.

2.2 Amortization cost

Amortization cost is that accumulated portion of the recorded cost of fixed assets that has been charged to expense through either depreciation or amortization. It is used to rate-ably reduce the cost of an intangible fixed asset. Amortization cost was estimated for cost of Nagpur mandarin with following formula,

$$A = \frac{(CXr)X\,(1+r)^t}{(1+r)^{t-1}}$$

Where,

A- Annual amortization cost in rupee

C- Initial capital investment in rupee

r- Discounting rate @ 12%

t- Expected economic life of the orchard (25 years)

2.3. Estimation of Cost of cultivation

To calculate the cost and returns of Nagpur mandarin simple tabular analysis was used. Cost of production of Nagpur Mandarin was calculated as per the standardized cost concept i.e. Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1, Cost C_2 and Cost C_3 benefit-cost ratio.

2.4. Impact assessment

Impact of HDP in Nagpur mandarin under Indo-Israel production technology over conventional cultivation was analyzed by using Partial budgeting technique.

Partial budgeting is used to find the economic viability of partial change in the farm such as use of new technology or new innovation or new practice. Partial budget approach was used for estimating the impact of research outcome on income generation. Partial budgeting is a method of organizing experimental data and information about the cost and benefits from some change in the technologies being used on the farm. The aim to estimate the change that will occur in farm profit or loss from some changes in the farm plan.

3. Results and Discussion

3.1 Establishment cost of HDP under Indo-Israel production technology and Conventional method Nagpur mandarin

Tables 1 and 2 revealed that establishment costs for Nagpur

mandarin cultivation under both high-density planting (HDP) and conventional methods exhibit significant differences in investment and distribution of expenses over a five-year period.

Comparing the two methods, HDP requires significantly higher investments both initially and throughout the five-year period. For instance, the overall cost of C3 for HDP (Rs.5,10,982.24) is substantially higher than that for the conventional method (Rs. 75,195.85). This difference is primarily due to the higher costs associated with grafts, labour, fertilisers, and the more intensive management required for HDP. Specifically, the cost of graft in HDP is nearly 13 times higher than in the conventional method. Hired labour and fertiliser costs in HDP are also markedly higher. Both methods generate returns from intercropping, but the specific returns for each year and overall are more balanced in the HDP method compared to the conventional method.

3.2 Amortization Cost of Nagpur mandarin cultivation

The amortization cost of Nagpur mandarin plantation establishment refers to the process of spreading the total establishment costs over the productive life of the orchard. This allows for an annualized view of the investment, making it easier to understand the financial burden yearly.

Table 3 revealed that the comparison between high-density planting (HDP) and conventional methods of Nagpur mandarin cultivation reveals significant differences in establishment and amortisation costs. Over the first five years, the total establishment cost for the HDP method is ₹510,982.24, substantially higher than the ₹375,979.24 required for the conventional method. This higher initial investment in the HDP method results in an annual amortization cost of ₹17,186.24 per hectare, compared to ₹14,476.53 for the conventional method. Despite these higher costs, the HDP method generates greater returns from intercropping, amounting to ₹47,964.00 compared to ₹33,461.00 for the conventional method. This suggests that while the HDP method is more expensive, it has the potential to be more profitable in the long run due to the higher income from intercropping. Growers must weigh the higher initial and annual costs against the potential for increased returns when deciding between the two methods. The conventional method, with its lower capital requirement and annual costs, may be more suitable for those with limited financial resources or who prefer a less intensive investment. Ultimately, the choice depends on the grower's financial capacity and their ability to manage the higher costs associated with the HDP method.

Table 1: Establishment cost of Nagpur mandarin in HDP under Indo-Israel production technology

Sr. No.	Particulars	1st year	2nd year	3rd year	4th year	5th year	Over all
1	Cost of Graft	28197.80	343.20	0.00	0.00	0.00	28541.00
2	**Hired Labour**						
	Male	19912.00	9936.00	6720.00	7526.40	7190.40	51284.80
	Female	3542.00	2688.00	1641.60	1598.40	1598.40	11068.40
	Sub total	23454.00	12624.00	8361.60	9124.80	8788.80	62353.20
3	Machine labour (hr)	4600.00	1288.00	884.00	1020.00	884.00	8676.00
4	Manure	12348.00	18706.00	21980.00	21890.00	24676.00	99600.00
5	**Fertilizer**						
	N	1650.00	1851.20	1908.00	1924.00	1976.00	9309.20
	P	1456.00	1669.20	1962.00	2030.40	2160.00	9277.60
	K	1252.80	1514.20	1649.80	1820.40	1931.40	8168.60
	Sub total	4358.80	5034.60	5519.80	5774.80	6067.40	26755.40
6	Irrigation	76760.00	3460.00	3580.00	3660.00	3660.00	91120.00
7	Plant protection	1620.00	1760.00	1780.00	1820.00	1830.00	8810.00
8	Incidental charges	1630.00	760.00	600.00	590.00	580.00	4160.00
9	Repairing charges	606.00	800.00	470.00	400.00	360.00	2636.00
10	Working Capital	162674.60	44775.80	43085.40	47065.60	46846.20	344447.60
11	Interest on Working capital @ 12%	19520.95	5373.09	5170.25	5647.87	5621.54	41333.71
12	Depreciation	3640.00	3680.00	3700.00	3700.00	3340.00	18060.00
13	Land revenue	125.00	108.00	104.00	98.00	99.00	534.00
14	Cost A1	185960.55	53936.90	52059.65	56511.47	55906.74	404375.31
15	Cost A2	185960.55	53936.90	52059.65	56511.47	55906.74	404375.31
16	Interest on Fixed capital @ 10%	9100.00	9500.00	9600.00	10700.00	10000.00	48900.00
17	Cost B1	195060.55	63436.90	61659.65	67211.47	65906.74	453275.31
18	Cost B2	195185.55	63544.90	61763.65	67309.47	66005.74	453809.31
19	Family labour	2160.00	2240.00	2140.00	2140.00	2040.00	10720.00
20	Cost C1	197220.55	65676.90	63799.65	69351.47	67946.74	463995.31
21	Cost C2	197345.55	65784.90	63903.65	69449.47	68045.74	464529.31
22	10% of Cost C2 (managerial cost)	19734.56	6578.49	6390.36	6944.95	6804.57	46452.93
23	Cost C3	217080.11	72363.39	70294.01	76394.42	74850.32	510982.24
24	Return from Inter cropping	13945	11851	9209	7301	5658	47964.00

Table 2: Establishment cost of Nagpur mandarin in Conventional method

Sr. No	Particulars	1St year	2nd year	3rd year	4th year	5th year	Over all
1	Cost of Graft	13843.40	255.00				7049.20
2	**Hired Labour**						
	Male	12844.00	9430.00	7590.00	8034.00	7204.00	9020.40
	Female	2320.00	1390.00	1036.8	1252.80	1425.60	1485.04
	Sub total	15164.00	10820.00	8626.80	9286.80	8629.60	10505.44
3	Manure	7040.00	9900.00	9940.00	15940.00	20340.00	12632.00
4	**Fertilizer**						
	N	571.00	675.00	752.00	918.00	956.00	774.40
	P	427.20	833.00	923.80	1254.00	1514.00	990.40
	K	500.00	746.00	858.00	1181.00	1585.00	974.00
	Sub total	1498.20	2254.00	2533.80	3353.00	4055.00	2738.80
5	Plant protection	830.00	810.00	730.00	830.00	890.00	818.00
6	Irrigation	3300.00	3320.00	3300.00	3300.00	3580.00	3360.00
7	Incidental charges (Include machine charge)	530.00	380.00	600.00	530.00	580.00	524.00
8	Repairing charges	400.00	404.00	470.00	400.00	360.00	406.80
9	Land revenue	98.00	110.00	104.00	98.00	99.00	101.80
10	Working Capital	33639.8	28143	26200.60	33639.80	38434.6	32011.56
11	Interest on Working capital @ 12%	4036.776	3377.16	3144.07	4036.78	4612.15	3841.39
12	Depreciation	3700.00	3680.00	3700.00	3700.00	3340.00	3624.00
13	Cost A1	41474.576	35310.16	33148.67	41474.58	46485.75	39578.75
14	Cost A2	125243.15	35310.16	35310.16	41474.58	46485.752	56764.76
15	Interest on Fixed capital @ 10%	9100.00	9500.00	9600.00	10700.00	10000.00	9780.00
16	Cost B1	134343.15	44810.16	42748.67	52174.58	56485.75	66112.46
17	Cost B2	134449.15	44920.16	42852.67	52272.58	56584.75	66215.86
18	Family labour	2160.00	2240.00	2140.00	2140.00	2040.00	2144.00
19	Cost C1	136503.15	47050.16	44888.67	54314.58	58525.75	68256.46
20	Cost C2	136609.15	47160.16	44992.67	54412.58	58624.75	68359.86
21	10 % of Cost C2 (managerial cost)	13660.92	4716.02	4499.27	5441.26	5862.48	6835.99
22	Cost C3	150270.07	51876.18	49491.94	59853.83	64487.23	75195.85
23	Return from intercropping operation	9854.00	7615.00	6232.00	5209.00	4551.00	33461.00

Table 3: Amortization Cost of Nagpur mandarin cultivation (Rs/ha)

Sr. No	Particulars	HDP	Conventional
1	First year	217080.11	150270.07
2	second year	72363.39	51876.18
3	Third year	70294.01	49491.94
4	Fourth year	76394.42	59853.83
5	Fifth year	74850.32	64487.23
6	Total establishment cost (C)	510982.24	375979.24
7	Discounting rate @ 12 % (r)	0.12	0.12
8	Life period (t)	25.00	25.00
9	Returns from intercropping	47964.00	33461.00
	Amortization cost	17186.24	14476.53

3.3 Estimation of cost and returns

Table 4: Cost of cultivation of Nagpur mandarin in HDP under Indo-Israel production technology

Sr. NO.	Particulars		Unit	Input	Cost/unit	Total cost	Percent to total cost
1	Hired Human Labour	Male	Days	76.30	383.59	29267.58	10.61
		Female	Days	51.24	250.00	12810.00	4.65
	Subtotal			127.54	329.92	42077.58	15.26
2	Bullock Labour		(Pair days)	14.73	450.00	6626.89	2.40
3	Machine Labour		Hours	65.57	617.57	40494.47	14.69
4	Manure		Qtl	150.00	400.00	60000.00	21.76
5	Fertilizer	N	Kg	322.00	18.69	6019.04	2.18
		P	Kg	252.00	45.58	11485.51	4.17
		K	Kg	132.00	21.33	2815.49	1.02
	Subtotal					20320.03	7.37
6	Drip Irrigation					3600.00	1.31
7	Micronutrient					2600.00	0.94
8	Plant protection					4020.00	1.46
9	Weedicide					1000.00	0.36

10	Incidental charges					1250.00	0.45
11	Repairing charges					2220.00	0.81
12	Working capital					187548.98	68.02
13	Interest on working capital @12%					22505.88	8.16
14	Depreciation					3340.00	1.21
15	Land revenue					150.00	0.05
16	Cost A1					225210.30	81.68
17	Rent paid for leased in land					0.00	0.00
18	Cost A2					225210.30	81.68
19	Amortization cost					17186.24	6.23
20	Interest on fixed capital @ 10%					13500.00	4.90
21	Cost B1					238710.30	86.58
22	Rental value of land					143506.24	52.05
23	Cost B2					238860.30	86.63
24	Family labour		Days	40.54	291.00	11797.44	4.28
25	Cost C1					250507.74	90.85
26	Cost C2					250657.74	90.91
27	10% of Cost C2					25065.77	9.09
28	Cost C3					275723.51	100.00
29	Yield per hectare		Qtl	235.00	2962.51	861186.46	
30	Per qtl.cost of main produce at cost C3					1173.29	

Table 5: Cost of cultivation of Nagpur mandarin in conventional method

Sr. No.	Particulars		Unit	Input	Cost/unit	Total cost	Percent to total cost
1	Hired Human Labour	Male	Days	36.18	404.13	14622.44	9.37
		Female	Days	25.00	254.99	6374.74	4.08
	Subtotal			61.18	343.19	20997.18	13.45
2	Bullock Labour		(Pair days)	5.50	349.72	1925.00	1.23
3	Machine Labour		Hours	25.74	582.36	14989.82	9.61
4	Manure		Qtl	80.00	402.87	32229.52	20.65
5	Fertilizer	N	Kg	145.50	15.58	2266.49	1.45
		P	Kg	103.70	39.65	4111.82	2.63
		K	Kg	56.56	20.77	1174.73	0.75
	Subtotal					7553.04	4.84
6	Irrigation					3122.00	2.00
7	Micronutrient					950.00	0.61
8	Plant protection					1772.42	1.14
9	Weedicide					580.60	0.37
10	Incidental charges					773.52	0.50
11	Repairing charges					1395.00	0.89
12	Working capital					88411.60	56.65
13	Interest on working capital @12%					10609.39	6.80
14	Depreciation					2123.50	1.36
15	Land revenue					102.00	0.07
16	Cost A1					117181.04	75.09
17	Rent paid for leased in land					0.00	0.00
18	Cost A2					117181.04	75.09
19	Amortization cost					14476.54	9.28
20	Interest on fixed capital @ 10%					10525.00	6.74
21	Cost B1					127706.04	81.83
22	Rental value of land					52096.86	33.38
23	Cost B2					127808.04	81.90
24	Family labour		Days	35.23	399.22	14064.35	9.01
25	Cost C1					141770.38	90.84
26	Cost C2					141872.38	90.91
27	10% of Cost C2					14187.24	9.09
28	Cost C3					156059.62	100.00
29	Yield per hectare		Qtl	103.00	3035.76	318443.45	
30	Per qtl.cost of main produce at cost C3					1515.14	

The cost incurred by Nagpur mandarin growers on practices after fruiting the crops for cultivation is categorised as the cost of cultivation. The cost of cultivation included expenses on various items, *viz*., weeding, hoeing, manures and fertilisers, plant protection measures, irrigation charges, etc.,

The per hectare cost of cultivation of Nagpur mandarin in HDP under Indo-Israel production technology and conventional method was worked out and presented in tables 4 and 5 respectively.

The HDP method, while significantly more expensive with a

total cultivation cost of ₹275,723.51 per hectare, yields a substantially higher output of 235.00 quintals per hectare. In contrast, the conventional method, with a total cost of ₹156,059.62 per hectare, produces only 103.00 quintals. This higher yield in the HDP method results in a more favorable cost per quintal of ₹1173.29, compared to ₹1515.14 under the conventional approach.

Despite the higher initial investment required for the HDP method, it demonstrates better cost efficiency due to the increased yield. The lower cost per quintal in HDP suggests that, over time, the higher upfront costs could be offset by the greater returns from higher production levels. In contrast, the conventional method, while less capital-intensive, results in a higher cost per unit of produce, potentially limiting profitability.

Table 6: Economics of Nagpur mandarin cultivation in HDP under Indo-Israel production technology and Conventional method Nagpur mandarin

Sr. No.	Particulars	HDP	Conventional
1	Main Produce (q/ha)	235.00	103.00
2	Value of Main Produce	861187.46	318443.45
3	Gross return	861187.46	318443.45
4	**Cost of cultivation at**		
	Cost A1	225210.30	117181.04
	Cost A2	225210.30	117181.04
	Cost B1	238710.30	127706.04
	Cost B2	238860.30	127808.04
	Cost C1	250507.74	141770.38
	Cost C2	250657.74	141872.38
	Cost C3	275723.51	156059.62
5	**Return at**		
	Cost A1	635977.16	201262.41
	Cost A2	635977.16	201262.41
	Cost B1	622477.16	190737.41
	Cost B2	622327.16	190635.41
	Cost C1	610679.72	176673.07
	Cost C2	610529.72	176571.07
	Cost C3	585463.95	162383.83
6	**Input Output Ratio at**		
	Cost A1	3.82	2.72
	Cost A2	3.82	2.72
	Cost B1	3.61	2.49
	Cost B2	3.61	2.49
	Cost C1	3.44	2.25
	Cost C2	3.44	2.24
	Cost C3	3.12	2.04

Table 6 revealed economic comparison between High-Density Plantation (HDP) using Indo-Israel technology and the conventional method for cultivating Nagpur mandarin highlights significant advantages for the HDP approach. HDP achieves a much higher yield of 235 quintals per hectare, more than doubling the 103 quintals produced by the conventional method. This results in a gross return of ₹861,187.46 per hectare for HDP, far surpassing the ₹318,443.45 generated by the conventional method.

Although HDP incurs higher cultivation costs, with a total Cost C3 of ₹275,723.51 compared to ₹156,059.62 for the conventional method, it still delivers much greater net returns. At Cost C3, HDP offers a return of ₹585,463.95 per hectare, significantly higher than the ₹162,383.83 from the conventional method. Additionally, the input-output ratio for HDP is 3.12, indicating superior efficiency compared to the 2.04 ratio for the conventional method.

3.4. Impact of HDP in Nagpur mandarin under Indo-Israel production technology over conventional Nagpur mandarin cultivation

The economic impact analysis of adopting High-Density Plantation (HDP) using Indo-Israel technology for Nagpur mandarin cultivation shows a significant financial advantage over the conventional method. Although HDP incurs additional costs totaling ₹134,493.56 per hectare, due to increased expenses in areas such as hired labor, machine labor, manure, and fertilizers, it also generates substantial additional returns of ₹339,070.04 per hectare. These returns stem primarily from the increased yield of 117 quintals over the conventional method. As a result, the net profit increase with HDP is ₹204,576.48 per hectare. This analysis clearly indicates that transitioning to HDP under Indo-Israel technology significantly boosts profitability, making it a more lucrative option compared to conventional cultivation methods.

Table 7: Economic impact of HDP in Nagpur mandarin under Indo-Israel production technology over Conventional method using Partial budgeting technique (Rs/ha)

Debt side			Credit side		
Sr. No	**Particulars**	**Value**	**Sr. No**	**Particulars**	**Value**
A.	Additional Costs (for HDP)		D.	Additional Returns (from HDP)	
1	Hired Human Labour	21080.40		Added returns from HDP of Nagpur Mandarin 117qtl.	339070.04
2	Machine Labour	25504.65			
3	Bullock Labour	4701.89			
4	Manure	27770.48			
5	Fertilizer	12766.99			
6	Drip Irrigation	478.00			
7	Micronutrient	1650.00			
8	Plant protection	2247.58			
9	Weedicide	419.40			
10	Incidental charges	476.48			
11	Repairing charges	825.00			
12	Interest on working capital @12%	11896.49			
13	Depreciation	1216.50			
14	Rental value of land	17775.00			
15	Amortization cost	2709.70			
16	Interest on fixed capital @10%	2975.00			
	Total Additional cost	134493.56			
B.	Reduced Returns	Nil	E.	Reduced costs	Nil
C.	Total Financial losses(A)	134493.56	F.	Total Financial gains(B)	339070.04
Impact of HDP in Nagpur mandarin under Indo-Israel production technology over conventional Nagpur mandarin cultivation.					
G.	Net Change in Profit (F-C) = 204576.48				

4. Conclusion

The comparative analysis of Nagpur mandarin cultivation using High-Density Planting (HDP) under Indo-Israel Production Technology versus Conventional methods reveals that HDP offers substantial advantages in terms of productivity and profitability. HDP significantly outperforms Conventional methods with a yield of 235 quintals per hectare compared to 103 quintals per hectare and net returns of ₹585,464 versus ₹155,867, respectively. Despite the higher total cost of HDP cultivation, the cost per quintal is lower at ₹1,173.29 compared to ₹1,515.14 for Conventional methods, highlighting better cost efficiency. The Benefit-Cost Ratio for HDP stands at 3.12, which is notably higher than the Conventional method's 1.99, demonstrating that each rupee invested in HDP yields a greater return. Although HDP involves a higher initial investment and ongoing costs, the increased returns and improved cost efficiency make it a more viable and profitable option in the long run. For growers capable of managing the initial financial outlay, HDP offers a significantly better financial return, making it the preferred choice for maximizing profitability in Nagpur mandarin cultivation.

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