Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 1996-2000

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-11 pp. 1996-2000**
Journal homepage: http://www.ijcmas.com

Original Research Article

Effect of Integrated Nutrient Management on Economics of Black Carrot (*Daucuscarota* subsp. *sativus* var. *atrorubens*Alef.)

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A B S T R A C T

A field experiment was conducted at the experimental field of Division of Vegetable Science, SKUAST-Kashmir during *Rabi* of 2017-2018. The experiment was laid out in randomized complete block design in which different combinations of inorganic fertilizers, organic manures and biofertilizers were applied constituting nine treatments and were replicated thrice. The economic analysis of black carrot grown in Kashmir region showed net returns varied with different treatments under cultivation. Results obtained showed that treatment T_9 (50%N+ 25%P&K+ PSB+ KSB+ 50%VC) registered highest net returns of Rs 181866.3ha^{-1} and benefit cost ratio of 2.74followed by T_8 treatment ((50%N+ 25%P&K+ PSB+ KSB+ 50%FYM) recording the net returns of Rs 175406.3ha $^{-1}$ and benefit cost ratio of 2.72. Lowest returns of Rs104556.7 ha^{-1} and benefit cost ratio of 2.09 was observed with treatment T_1 (RFD).

Keywords

Black carrot, Economic analysis, Inorganic fertilizers, Organic manures

Introduction

Carrot is one of the major vegetable crops grown throughout the world (Vilela, 2004) and it is considered as an important economical vegetable due to its high yield per unit area (Hassan *et al.*, 2005). The black carrot is rich in phenolic content, flavinols, calcium, iron zinc, vitamin A, B, C, E and selenium. It also contains calcium pectate which is a very good source of fibre. As the crop is heavy feeder of nutrients, judicious and proper nutrient management is essential for increased growth and yield of the crop. In India, during the past three decades, intensive agriculture involving exhaustive high yielding varieties has led to heavy withdrawal of nutrients from the soil which resulted in decreased nutrient uptake, deterioration of soil structure and decrease in the microbial population in the soil which adversely affected the quality of vegetables (Agarwal, 2003). Moreover, in India, most of the farmers are small and marginal. Therefore, it

becomes very difficult for them to purchase the chemical fertilizers at the higher cost. On the other hand organic manures like farmyard manure, vermicompost are eco-friendly, cheap source of nutrients and key factor in restoring the productivity of degraded soils as they supply the multiple nutrients and improve the organic matter content in the soil which in turn improves the physical properties, enhances the biological diversity and soil microflora, leading to sustainable vegetable production, devoid of harmful residues (Acharaya and Mandal, 2002) and help to improve the quality of vegetables (Chatto *et al.*, 2003) however, it has been observed that the crop response to organic manures is not as spectacular as with the chemical fertilizers owing to the slow release of nutrients during the initial years. Biofertilizers also play an important role in maintaining the sustainability of soil as biofertilizers are ready to use live formulations of such beneficial microorganisms which on application to seed, root or soil mobilizes the availability of nutrients by their biological activity in particular and help to build up the soil micro-flora and thereby the soil health. Therefore, to maintain the soil fertility and to supply the plant nutrients in balanced proportion without compromising the yield and quality of the crop an integrated approach is to be practiced under specific agro-ecological situation through the combined use of inorganic and organic sources along with the application of biofertilizers.

Materials and Methods

The experiment was carried out at Experimental Farm, Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar. The experimental field is situated at 34.1^{o} North latitude and 74.89^{o} East longitude with an altitude of 1587 meters above mean sea – level. The experiment was laid out in randomized block design with nine treatments and three replications. The treatment combinations were T_1 RFD-(control), T_2(50%RFD+50%FYM), T_3(50% RFD+50%VC), T_4(50%N&K+25%P+PSB+ 50%FYM), T_5(50%N&K+25%P+PSB+ 50%VC), T_6(50%N&P+25%K+KSB+50% FYM), T_7(50%N&P+25%K+KSB+50%VC), T_8 (50%N+25%P&K+ PSB+KSB+ 50% FYM), T_9 (50%N+ 25%P&K+ PSB+ KSB+ 50%VC). Twenty seven plots of 3.0 m × 2.5 m size each were prepared as per layout specifications The seeds of Black carrot variety Local Black were sown at spacing of 30 cm × 15 cm. Recommended dose of Nitrogen, Phosphorus and Potassium (90:60:60 kg ha^{-1}) was provided through urea, diammonium phosphate and muriate of potash according to the treatment. Organic manures viz., well decomposed farmyard manure (FYM), vermicompost were incorporated as per treatments to respective plots 15 days prior to sowing on the basis of nitrogen percentage. Biofertilizers (PSB&KSB) @ 5 l ha^{-1} were applied into the respective treatments before sowing of seed. Economic analysis of black carrot was studied under integrated nutrient management system in which total variable cost, fixed cost was calculated to determine the cost of cultivation of black carrot. Further, treatment wise added costs, gross returns, net returns and returns per rupee invested were calculated for different treatments.

Results and Discussion

The data presented in table 1 reveals the cost involved on fixed and variable factors per hectare for black carrot production under integrated nutrient management. It is apparent from table 1 that total fixed cost and variable cost was found to be Rs.32367.2 ha^{-1} and Rs.55417.5ha^{-1} respectively for black carrot production under integrated nutrient management. The data in table 2 reveals

treatment wise added cost in the cultivation of black carrot grown under integrated nutrient management. It is evident from the data that the additional cost can be added as the expenditure on all treatments except control owing to the cost of manures, fertilizers, biofertilizers and number of labourers.

The data presented in table 3-4 reveals that net capital investment showed variation with different treatments in black carrot cultivation. It is evident from table 3 that maximum cost of cultivation (Rs.104386.3 ha^{-1}) was estimated in treatment T_7 (50%N&P+25%K+KSB+50%VC) and lowest was recorded in treatment T_1(RFD) which accounted for Rs 95493.3 ha^{-1}. It can be further seen from table 3 that pooled yield was highest in treatment T_9 (50%N+25%P& K+PSB+KSB+50%VC) recording the value of 285.79q ha^{-1}followed by treatment T_8(50% N+ 25%P&K+PSB+KSB+50% FYM) recording the value of 276.83q ha^{-1} which can be directly related to gross returns per hectare.

It is apparent from the data presented in table 4 that maximum returns of Rs.181866.3 ha^{-1} were registered with treatment T_9(50%N+25%P&K+PSB+KSB+50%VC)fol lowed by treatment T_8 (50%N+25%P& K+PSB+KSB+50%FYM) recording the value of 175406.3 ha^{-1} with returns per rupee invested of 2.74 and 2.72, respectively. The lowest net returns of Rs104556.7 ha^{-1} was recorded in treatment T_1 (RFD) with returns per rupee invested of 2.09. The reasons for these findings could be attributed to higher root yield under treatment T_9 (50%N+25%P & K+PSB+KSB+50%VC) which was found to be directly associated with increasing gross income and net returns accordingly. The results are in agreement with (Sunandarani and Mallareddy, 2007) and (Vithwel and Kanaujia, 2013).

Table.1 Cost involved on variable and fixed factors $ha^{-1}$for black carrot

A.	Preparatory tillage (four ploughings) at ₹ 3000.00 ha^{-1}	12000.00
	Clod breaking/ levelling (27 labourers at ₹ 225.00 $labour^{-1}$)	6075.00
	Preparation of beds/channels (30 labourers at₹ 225.00 $labour^{-1}$)	6750.00
	Seed Sowing (25 labourers at ₹ 225.00 $labour^{-1}$)	5625.00
	Total A	**30450 .00**
B.	Irrigation (10 labourers at ₹ 225.00 $labour^{-1}$)	2250.00
C.	Cultural operations (three hand weedings/hoeings 40 labourers at ₹ 225.00 $labour^{-1}$)	9000.00
D.	After care operations (10 labourers at ₹ 225.00 $labour^{-1}$)	2250.00
E.	Harvesting and related operations (24 labourers at ₹ 225.00 $labour^{-1}$)	5400.00
	Total (B+C+D+E)	**18900.00**
	Total (A+B+C+D+E) working capital	**49350.00**
	Incidental charges at 5 percent of the working capital	2467.5
	Total labour component involved in total cost of cultivation	51817.5
	Cost of seed at ₹ 1000 kg^{-1} for 3.6kg seed ha^{-1}	**3600.00**
	Variable cost (labour + cost of seed)	**55417.5**
	Land rent @Rs 150 $kanal^{-1}$	30000
	Land tax	140
	Depreciation on implements	1000
	Total	31140
	Interest at 6.5 percent on fixed factor	1227.2
	Total fixed cost (31140+ 1227.2)	**32367.2**

Table.2 Treatment wise added cost in the cultivation of black carrot(ha^{-1} basis)

	Treatment combinations	Cost involved on fertilizers (N+P+K) Rsha^{-1}	Cost involved on manures& biofertilizers Rsha^{-1}	No. of labourers involved in @ Rs 225	Amount involved on labourers @Rs 225	Total added cost Rsha^{-1}
T_1	RFD	5233.6	0.00	11	2475	7708.6
T_2	50% RFD+50%FYM	2616.8	9000	11	2475	14091.8
T_3	50% RFD+50% VC	2616.8	11500	11	2475	16591.8
T_4	50%N&K+25%P+PSB+ 50%FYM	1834.4	9319.8	11	2475	13629.2
T_5	50%N&K+25%P+PSB+ 50%VC	1834.4	11819.8	11	2475	16129.2
T_6	50%N&P+25%K+KSB +50%FYM	2306.8	9319.8	11	2475	14101.6
T_7	50%N&P+25%K+KSB +50%VC	2306.8	11819.8	11	2475	16601.6
T_8	50%N+25%P&K+PSB+ KSB+50%FYM	1524.4	9639.6	11	2475	13639
T_9	50%N+25%P&K+PSB+ KSB+50%VC	1524.4	12139.6	11	2475	16139

Table.3 Treatment wise comparative economics of cost of cultivation of black carrot (ha^{-1})

	Treatment combinations	Fixed Cost (Rs ha^{-1})	Variable Cost (Rs ha^{-1})	Total added Cost (Rs ha^{-1})	Total variable Cost (Rs ha^{-1})	Total cost of cultivation (Rs ha^{-1})	Pooled Yield (q ha^{-1})
T_1	RFD	32367.2	55417.5	7708.6	63126.1	95493.3	200.05
T_2	50% RFD+50%FYM	32367.2	55417.5	14091.8	69509.3	101876.5	214.8
T_3	50% RFD+50% VC	32367.2	55417.5	16591.8	72009.3	104376.5	222.08
T_4	50%N&K+25%P+PSB+ 50%FYM	32367.2	55417.5	13629.2	69046.7	101413.9	253.99
T_5	50%N&K+25%P+PSB+ 50%VC	32367.2	55417.5	16129.2	71546.7	103913.9	263.75
T_6	50%N&P+25%K+KSB +50%FYM	32367.2	55417.5	14101.6	69519.1	101886.3	232.77
T_7	50%N&P+25%K+KSB +50%VC	32367.2	55417.5	16601.6	72019.1	104386.3	242.38
T_8	50%N+25%P&K+PSB+ KSB+50%FYM	32367.2	55417.5	13639	69056.5	101423.7	276.83
T_9	50%N+25%P&K+PSB+ KSB+50%VC	32367.2	55417.5	16139	71556.5	103923.7	285.79

Table.4 Economics of production under different treatments in the cultivation of black carrot (ha^{-1})

	Treatment combinations	Total cost of cultivation (Rs $ha^{-1)}$	Pooled Yield (q ha^{-1})	Gross Returns (Rs ha^{-1})	Net Returns (Rs ha^{-1})	B:C Ratio (Rs $ha^{-1)}$
T_1	RFD	95493.3	200.05	200050	104556.7	2.09
T_2	50% RFD+50%FYM	101876.5	214.8	214010	112133.5	2.10
T_3	50% RFD+50% VC	104376.5	222.08	222080	117703.5	2.12
T_4	50%N&K+25%P+PSB+50% FYM	101413.9	253.99	253990	152576.1	2.50
T_5	50%N&K+25%P+PSB+50% VC	103913.9	263.75	263750	159836.1	2.53
T_6	50%N&P+25%K+KSB+50% FYM	101886.3	232.77	232770	130883.7	2.28
T_7	50%N&P+25%K+KSB+50% VC	104386.3	242.38	242380	137993.7	2.32
T_8	50%N+25%P&K+PSB+KSB +50%FYM	101423.7	276.83	276830	175406.3	2.72
T_9	50%N+25%P&K+PSB+KSB +50%VC	103923.7	285.79	285790	181866.3	2.74

Gross returns = Yield × Cost of Black carrot**; Net Returns** = Gross Returns-Total cost of cultivation ;
B:Cratio = Gross Returns/Total Cost of cultivation

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