Effect of organic manures and natural farming on quality and economics of carrot

Abstract-

The objective of the experiment was to examine the effects of organic manures and natural farming on the quality and economics of carrots. It was conducted at the research farm of the Deen Dayal Upadhyaya Centre of Excellence for Organic Farming of CCS Haryana Agricultural University, Hisar, during the *rabi* season 20022–2023. Three replications and eight treatments were included in the RBD design of the experiment. Three different organic manures were applied: FYM, vermicompost, poultry manure and in combination with biofertilizers (*Azatobacter* and PSB). Treatment of cow based bio-formulations (Ghanajeevamrit and Jeevamrit) and control was also included as treatment where no biofertilizersand manure were used. The study revealed significant improvements in almost all quality attributes due to thecombinedapplicationoforganicmanures along with biofertilizers.Amongdifferenttreatments, vermicompost + biofertilizer surpassed all other treatments by giving maximum root yield (283.4 qha^{-1}),maximum content of the total sugar (8.79%), reducing sugar (4.09%), non-reducing sugar (4.64%), TSS (11.5°Brix) and Chlorophyll content in leaves (4.37 nmol cm^{-2}). Also, the treatment vermicompost + biofertilizersgave maximumgross return (Rs. 425100 ha^{-1}), net return (Rs. 232873 ha^{-1}),), and BC ratio (2.21) during the experiment. It was alsoobservedduringthe studythatcontroltreatmentshowedlowestfindingsamong all the treatments.

Keywords- Biofertilizers, Organic manures, Quality, Sugar content.

Introduction

Vegetables are thought to be an essential dietary supplement that can help to maintain overall health and protect against some illnesses that are degenerative. Carrot (*Daucus carota* L.) is a winter season crop and member of the Apiaceae family and is utilised in human diets for a variety of purposes. It contains high amount of nutrients. India's main vegetable crop is carrot. India's major states for the production of carrots include Uttar Pradesh, Haryana, Andhra Pradesh, Karnataka, and Punjab.

Carrot roots are consumed as a raw vegetable in salad form or in boiled form, also soups and pickle is prepared from the carrot (Anjum and Amjad, 2002). Many refreshing drinks which is healthy and tasty is produced from carrot with combination of other vegetables.Carrot is the source of beta-carotene (precursor of vit- A). Carrot helps in maintaining nitrogen balance and increase the quantity of urine (Anjum and Amjad, 2002).

Organic manures are prepared from the product of plantor animal after decomposing.But raw materials are not collected from unsafe sources (such as industrial waste, toxic waste, hospital waste etc.). Using technologies like the frequent application of synthetic chemicals like pesticides and fertilisers, the adoption of high-yielding varieties, increased use of irrigation potentials, etc., can lead to a "green revolution" and increase production output in most situations. However, the persistent and careless utilisation of these substantial resources is currently causing a reduction in the yield and efficiency of many crops, in addition to worsening the conditions of the soil and surrounding environments.

The organic manure could increase the fertility and productivity of the land and improve physical and chemical properties of soil as well asproduce nutritive and chemical residue free vegetables (Ramesh *et al.*, 2005).The demand for organic produce is increasing with increasing awareness (Bhatta *et al.,* 2009). Both domestically and internationally, there is a growing demand for organic veggies. Consumers expect organic food to have a higher nutritional value, while being free of chemical residues (Ditlevsen et al. 2019). Food/vegetables that are produce under the organic system of cultivation contain a higheramount of secondary metabolites, vitamins and various mineral nutrients (Seufert and Ramankutty 2017). Organic manuresare the alternate of the chemical fertilizers. Manures supply the required nutrients for the long time and in adequate amount, improve soil structure, increase microbial population and at the same time maintain the quality of crop produce (Wong *et al.*, 1999, Suresh et al., 2004 and Dauda *et al.*, 2008).Farm yard manure is a natural source of available nitrogen. It adds humus and slow releasing nutrients to the soil and restores soil fertility by improving a wide range of natural properties of soil. Vermicompost is a valuable organic fertilizer. Earthworm promotes rapid decomposition with increased rate of mineralization, humification of organic matter and increased microbial biomass that improves the quality of the final product (Atiyeh *et al.*, 2002). Poultry manure is a more concentrated source of crop nutrients, especially nitrogen, phosphorus, potassium and calcium.

Material methods

The experiment was carried out at Research farm of Deen Dayal Upadhyaya Centre of Excellence for Organic Farming of CCS Haryana Agricultural University, Hisar during the *rabi* season 2022-23 under organic system of cultivation without using any chemicals is located at 29°8’20” N latitude and 75°42’04” E longitude at an elevation of 213 metre above mean sea level (MSL) in the sub-tropics of the country and characterized by semi-arid climatic zone. The soil of experimental field was sandy loam in texture containing 157, 15.70 and 364.00 kg ha^{-1} available nitrogen, phosphorus and potassium, respectively in 0-15 cm soil depth with EC 0.78 dS m^{-1}, pH 7.80 and organic carbon content 0.67 per cent. The treatment combinations were setup as per recommended dose of Nitrogen for carrot crop in that is 60 kg ha^{-1}. The experiment was laid out in a randomized block design (RBD) with three replications and 8 treatment combinations. Seed of carrot cultivar Punjab carrot 161 was sown in net plot of 4.5m × 4.0m on 16 October, 2023. The treatments were

T_1= RDN through FYM

T_2= RDN through vermicompost

T_3= RDN through poultry manur

T_4= RDN through FYM + biofertilizers*

T_5= RDN through vermicompost + biofertilizers*

T_6= RDN through poultry manure + biofertilizers*

T_7= cow based bio-formulations (Ghanajeevamrit and Jeevamrit)

T_8= control.

(**Azotobector* + PSB)

Whereas, organic manures i.e., FYM, vermicompost, poultry manures and biofertilizers applied @ 9210, 3157, 2143 kg ha^{-1} and 50 ml each of *Azatobecter* and PSB for seed treatment. Cow based bio-formulations (Ghanajeevamrit and Jeevamrit) was applied @ 250 kg Ghanajeevamrit + 250 FYM kg/ha and 125 litre Jeevamrit in three split doses at 20, 40 and 60 DAS @ 5 %, 10% and 10%, respectively. Sugar % was analysed according to Lane and Eyon method. For the measurement of TSS Refractometer was used.

Data collected

Data of quality parameters *viz.*, total sugar %, reducing sugar and non-reducing sugar % and TSS °Brix,respectively were taken from the plant's samplesafter harvest.Lane and Eynon method as given by Ranganna 1994 was used for estimation of sugar and expressed in percentage.TSS was calculated with the use of refractometer. Economics were taken from each plot and converted into per hectare. The economics were calculated on the basis of DDUCE-OF current price of input and output and stated in the form of net return.

Table 1- Analysis of nutrient composition of organic manures used during experiment

Sr. no.	Organic Manure	Nitrogen(N) (%)	Phosphorous (P) (%)	Potassium (K) (%)
1.	FYM	0.65	0.42	0.84
2.	Poultry manure	2.80	1.59	1.72
3.	Vermicompost	1.89	0.85	0.96

Result and discussion

Application of organic manures alone and with biofertilizers significantly influence the quality attributes of the carrot *viz.*, total sugar, reducing sugar, non-reducing sugar and TSS nutrient content. The maximum content (8.79%) of the total sugar, reducing sugar (4.09%), non-reducing sugar (4.64%) and TSS (11.5°Brix) was recorded in T_5 with the application of RDN through vermicompost and seed was treated with the biofertilizers, which was at par with the treatment of T_2 and T_4 (table 2). However, in total sugar and non-reducing sugar treatment T_5 was also at par with the treatment T_1. The lowest or minimum content of total sugar, reducing sugar, non-reducing sugar and

TSS were recorded with the control treatment. The greater availability and absorption of nutrients in combination with manures contributed to the balanced C/N ratio and increased activity of plant metabolism, which may improve nutrition quality features in carrot as suggested by Emura and Hosoya (1979).Manures that include higher nitrogen levels appear to have encouraged photosynthetic activity and rapid vegetative growth, which in turn led to a bigger accumulation of food material i.e., carbohydrates and an increase in the TSS content of plants.The results were in close conformity with Wafaa (2013) and Mahala *et al.* (2018).

The data depicted in table 2 showed that there was no significant difference observed in chlorophyll content at 30 DAS, whereas at 60 and 90 DAS, application of organic manures with or without biofertilizers and cow based formulation significantly affected the chlorophyll content in leaves.

At 60 DAS, chlorophyll content was recorded significantly higher (3.23 nmol cm^{-2}) in T_5 which was at par with T_1, T_2, T_4 and T_6 (3.11, 3.06, 3.15 and 2.92nmol cm^{-2}, respectively) and higher than all other treatments. At 90 DAS, the same trend was observed and found that T_5 that received RDN through vermicompost + biofertilizers have significantly maximum chlorophyll content (4.37 nmol cm^{-2}), and was significantly higher than all other treatments except T_2 and T_4 (3.93 and 4.15 nmol cm^{-2}, respectively). Moreover, treatment cowbased formulations showed no significant differences in chlorophyll content (3.01 nmol cm^{-2}) as compared to the control (2.95 nmol cm^{-2}).Total chlorophyll content is directly proportional to the availability of the nitrogen that plays an important role in the process of photosynthesis, also the increasing of nitrogen content and leaf area with organic fertilizers directly correlated with an increase in total chlorophyll content (Larimi*et al.*, 2014). The similar results were also found by Zeid *et al.* (2015) and Schimidt*et al.* (2018).

Economics

It was resulted that the application of recommended dose of nitrogen through vermicompost and seed treated with biofertilizer recorded the highest cost of cultivation (Rs. 192227), gross return (Rs. 425100), net return (Rs. 232873) and best benefit cost ratio (2.21)(table 3), which was highest because of higher root yield per hectare with application of RDN through vermicompost along with biofertilizers as compared to other treatments.

Table 2: Effect of organic manures and natural farming on total sugar, reducing sugar and non-reducing sugar and TSS

Treatments	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	TSS (°Brix)	Chlorophyll content in leaves		
					30 DAS	60 DAS	90 DAS
T_1	8.47	3.94	4.55	10.2	1.93	3.06	3.65
T_2	8.64	3.98	4.5 5	10.9	2.00	3.11	3.93

T_3	8.14	3.89	4.25	10.0	1.83	2.83	3.31
T_4	8.53	4.04	4.57	10.6	2.10	3.15	4.15
T_5	8.79	4.09	4.64	11.5	2.13	3.23	4.37
T_6	8.22	3.89	4.33	10.1	1.83	2.92	3.43
T_7	8.01	3.83	4.18	9.8	1.83	2.74	3.01
T_8	7.93	3.80	4.13	9.2	1.80	2.64	2.95
SEm (±)	0.16	0.04	0.06	0.4	0.18	0.13	0.18
CD at 5 %	0.48	0.11	0.18	1.1	N.S	0.38	0.56

Table 3: Effect of organic manures and natural farming on yield, cost of cultivation, gross return, net return and BC ratio

Treatments	Root yield (q ha^{-1})	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	BC Ratio
T_1	265.9	189754	398850	209096	2.10
T_2	275.1	192103	412650	220547	2.15
T_3	248.1	187697	372150	184453	1.98
T_4	271.2	189878	406800	216922	2.14
T_5	283.4	192227	425100	232873	2.21
T_6	254.7	187845	382050	194205	2.03
T_7	241.7	181838	362550	180712	1.99
T_8	220.8	178425	331200	152775	1.86
SEm (±)	7.5	-	-	-	-
CD at 5 %	22.9	-	-	-	-

Conclusion

Based on the experimental results it can be showed that the application of 100% RDN through vermicompost along with biofertilizers (*Azotobacter* and PSB) showed superior performance over other treatments which was at par with the treatments in which recommended dose of nitrogen was provided through vermicompost and RDN through FYM along with biofertilizers. Significantly maximum sugar content, net return (Rs 232879 ha^{-1}), BC ratio (2.21) closely followed by RDN through vermicompost (RS. 220547 and BC ratio 2.15), RDN through farm yard manure + biofertilizers (Rs. 216922 and BC ratio 2.14) and RDN through farmyard manure (Rs. 209096 and BC ratio 2.10) in organic cultivation system of carrot. In addition to enhancing soil health the application of organic based fertilizers can substitute the chemical fertilizers. So, the use of organic manures along with biofertilizers directly benefit to the farmers by reducing the cost of cultivation.

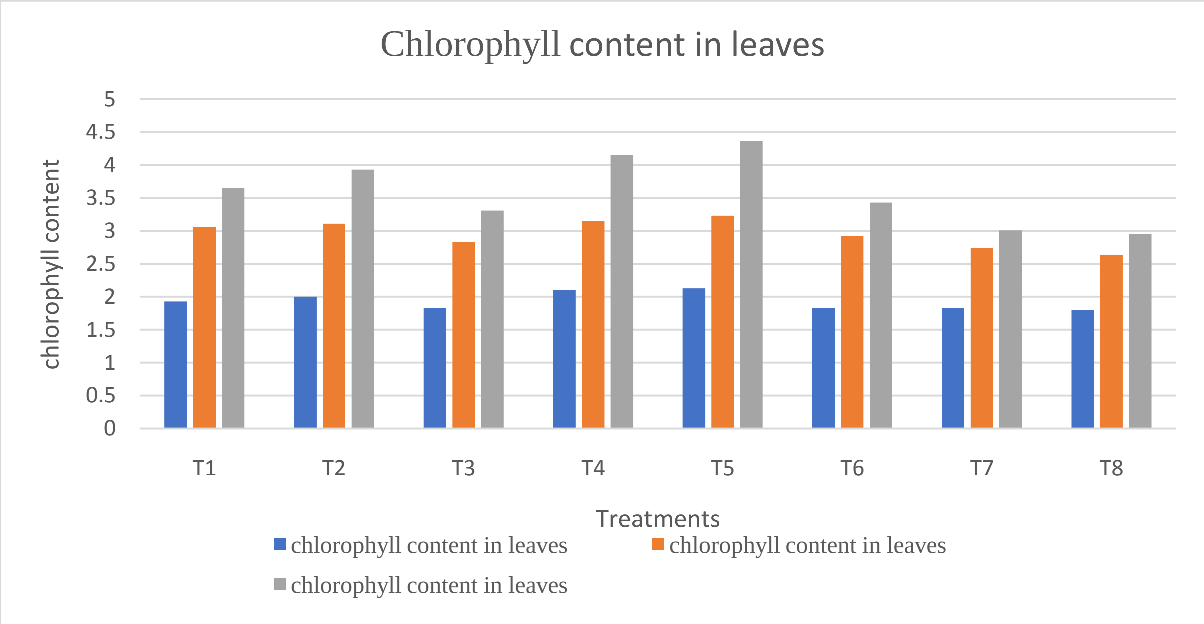

Figure 1: Effect of organic manures and natural farming on chlorophyll content in carrot leaves

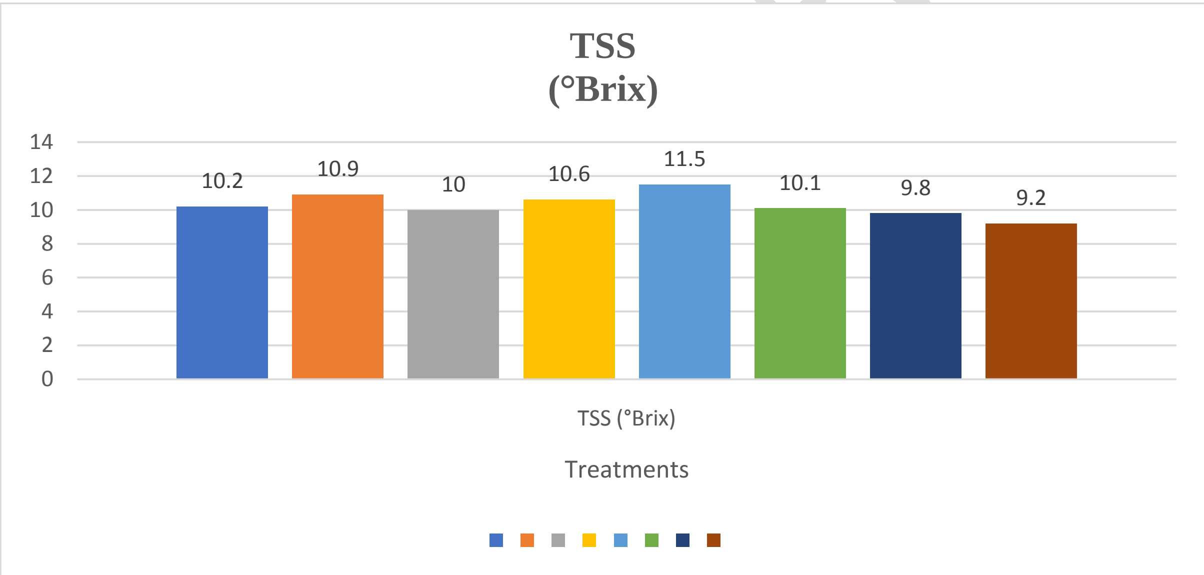

Figure 2: Effect of organic manures and natural farming on TSS of carrot

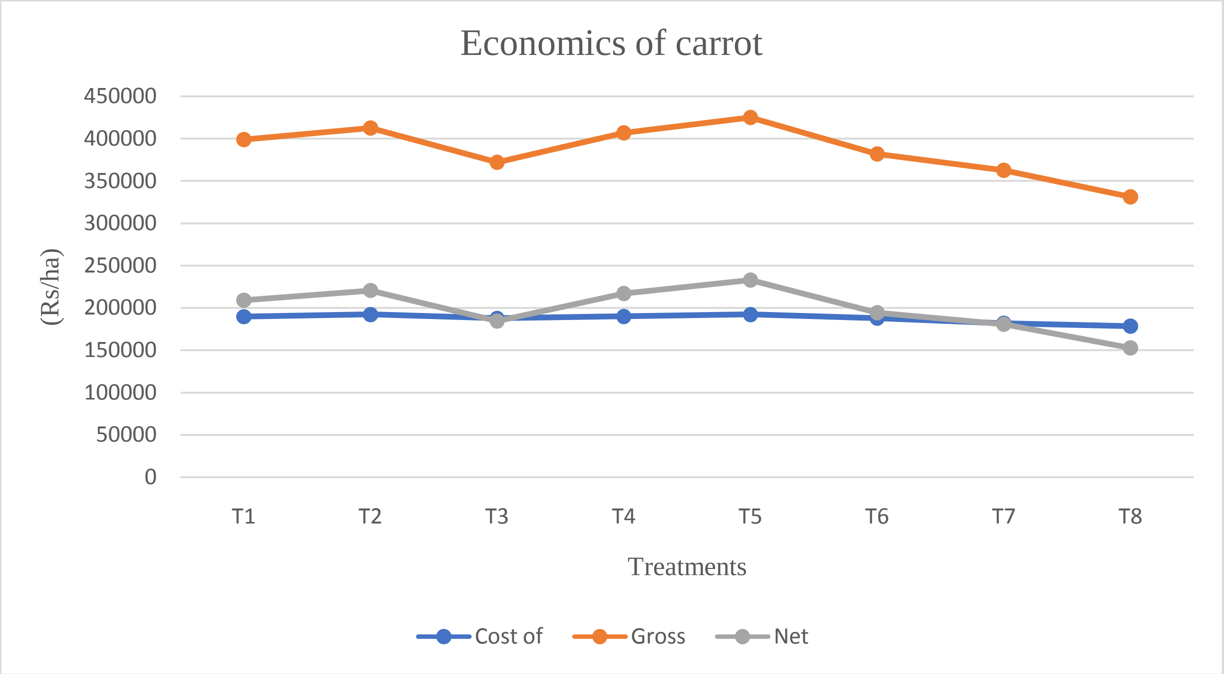

Figure 3: Effect of organic manures and natural farming on cost of cultivation, gross return and net return

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