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RESEARCH PAPER

Effect of organic manures on growth and yield of carrot (*Daucus carota* L.) under low hill of Uttrakhand

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Abstract : An experiment was performed during the year 2021-22 at Horticulture Research Block, Department of Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India to examine the "Effect of organic manure on growth and yield of carrot (*Daucas carota* L.) under low hills of Uttarakhand". The experiment was laid out in Randomized Block Design with three replications and nine treatments. The treatments comprised following levels of various organic nutrients concentrations *viz.,* T_1-Control, T_2-FYM@20t/ha, T_3- Vermicompost@5t/ha, T_4- Cow Urine @ 20%, T_5- FYM @10t/ha + Vermicompost @ 2.5t/ha + Cow Urine @ 10%, T_6- FYM @10t/ha + Vermicompost @ 2.5t/ha, T_7- FYM @10t/ha + Cow Urine @ 10%, T_8- Vermicompost @ 2.5t/ha + Cow Urine @10%, T_9- FYM @20t/ha + Vermicompost @5 t/ha + Azotobacter @5.0 kg/ha. Among all, the organic treatment with Farmyard Manure (100%) + Vermicompost (100%) + Azotobacter (5.0 Kg/ha) has sown the significant improvement in growth and yield parameters than other treatments. The treatment recorded highest plant height (cm), Number of leaves per plant, Length of leave (cm), Width of leaves (cm), Root length (cm), Root diameter (cm), Fresh weight (g), Dry weight (g) and yield (kg/plot).

Key Words : Organic manure, Vermicompost, Cow urine, FYM, Azotobacter

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INTRODUCTION

Carrot (*Daucus carota* L.) is one of the most popular root vegetable crop in the world and the member of Apiaceae family which was previously known as Umbelliferae. It is considered to be a native of Mediterranean region (Pierce, 1987). It is well distributed throughout the temperate, tropical and subtropical parts of the world (Bose and Som, 1990) and extensively cultivated in Europe, Asia, North Africa and North and South America (Thompson and Kelly, 1957). It is considered as a root crop and used for making soups, curry salads, stews and pickles. In many countries, top leaves are used as poultry feed and as a supply for extraction of leaf proteins (Zhang *et al*., 2017; Arscott and Tanumihardjo, 2010). Although, carrot crop has many potentialities and widely cultivated since long time, yet its yield per acre remains very low. Many production problems like faulty nutrient application and the type of

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fertilizer, lack of recommended spacing, irritation problem, date of planting, have been some of the factors, which contributed to the low productivity of carrot in our country. Carrot contains higher amount of carotene (l0mg/l00g), thiamin (0.04mg/100g), riboflavin (0.05mg/100g) and also serves as a source of carbohydrate, protein, fat, minerals, vitamin -C and calories (Yawalkcr,1985). Sugar and volatile terpenoids are the two major components of carrot flavor; glucose, fructose and sucrose which make up more than 95% of the free sugars and 40% to 60% of the stored carbohydrates in the carrot root. The ratio of sucrose to reducing sugar increases with root maturity but decreases following harvest and during cold storage (Freman and Simon, 1983). Blindness in children for the serve vitamin-A deficiency is a problem of public health in some countries, particularly in the rice dependent countries of Asia (Woolfe, 1988). So, carrot (rich in vitamin-A) may contribute a lot of vitamin-A to overcome this situation. Carrots are also an excellent source of dietary fibre. Fibre is a crucial part of a healthy diet. Fibre can be found in many fruits and vegetables and can help maintain a healthy weight and lower risk of heart disease. Carotenoids and vitamins that are found in carrots act as antioxidants, anticarcinogens and immune enhancers. Carotenoids are the yellow, orange and red colored phytochemicals found in most carrots. Carotenoids are a major source of dietary vitamin A and provide antioxidant activity. They are beneficial for the prevention of major health problems, such as cancer and cardiovascular diseases. The consumer recognition of the many health benefits of carrots has contributed to the rapid rise in popularity of carrots in the diet. The type and the way producers are applying fertilizer is one of the major serious problems in carrot production (Hailu *et al.,* 2008). It has been reported that excessive amounts of inorganic fertilizers are being applied to vegetables in order to achieve a higher yield (Abou *et al.,* 2012). However, the use of inorganic fertilizers alone may cause problems for human health and the environment. In addition, the cost of inorganic fertilizers is getting expensive and therefore farmers could not afford to buy it for vegetable crop production.Under this situation utilization of locally available resources like organic matter is going to be meaningful for improving soil structure, microbial biomass and there by contributing for improving yield and crop productivity of carrot in the country. Therefore, utilization of locally produced cattle manures by vegetable producers may increase crop yields with less use of chemical fertilizer. In recent times, the study showed that organically grown fruits or vegetables contain more mineral and vitamins than conventionally grown ones (Bourn and Prescott, 2002). In this context, the use of organics and bio fertilizers like farmyard manure, poultry manure, cattle manure and azospirillum is gaining more importance for getting higher yield and quality. Cattle manure being bulky organic material releases the soil compactness and improves the aeration in addition to the supply of essential plant nutrients and organic matter and increase soil microbial establishment along with accumulation of excess humus content (Greene, 2007). Organically produced fruits, vegetables, food crops fetch much higher value not only in the international market but also in the domestic market. They are known to be devoid of any residues, thereby having positive impact on environment and human health. Several attempts have been made to increase the yield potential of root crops, but farmers are concerned with the use of inorganic fertilizers which results in decrease fertility of soil, soil health, contents of organic matter and decreases the microbial activity of soil (Chen *et al*., 2014). Vermicompost is regarded ecologically sound bio-fertilizer and also cost–effective and eco-friendly (Amooaghaie and Golmohammadi, 2017). Vermicompost is a potential source of readily available nutrients, growth enhancing substances and a number of beneficial micro-organisms like N-fixing, P-solubilizing and cellulose decomposing organisms (Singh *et al*., 2008; Archana and Anubha, 2011). It enhances soil fertility as it increases soil porosity, aeration, moisture holding capacity, available plant nutrients, acts as a complex fertilizer granules and accelerates nitrogen mineralization (Prabha *et al*., 2007; Azarmi *et al*., 2008; Martin and Brathwaite, 2012). It has been studied that the vermicompost effects on the plant growth, yield and quality of crops considerably. As a result, the seed germination, vigour, flowering and fruiting of plant, tuberization, development of root size colour shelf life and quality are apparently improved (Suthar *et al*., 2005 and Chanda *et al*., 2011). Observance this in vision, the present experimental research was planned and executed to study the effect of organic manures on growth and yield of carrot under lower hills of Uttarakhand.

MATERIAL AND METHODS

The present research trial was carried out at Horticulture Research Block, Department of

Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India, during the *Rabi* season of 2021–22. The experiment was laid out in Randomized Block Design (RBD) and replicated thrice. Total nine treatments were tried namely T_1- Control, T_2- FYM@20t/ha, T_3- Vermicompost@5t/ha, T_4- Cow Urine @ 20%, T_5- FYM @10t/ha+ Vermicompost @ 2.5t/ha + Cow Urine @ 10%, T_6- FYM @10t/ha +Vermicompost @ 2.5t/ha, T_7- FYM @10t/ha + Cow Urine @ 10%, T_8- Vermicompost @ 2.5t/ha + Cow Urine @10%, T_9- FYM @20t/ha + Vermicompost @5 t/ha + Azotobacter @5.0 kg/ha. The experimental research field soil was sandy loam in texture having pH of 7.1 with available nitrogen (220.04%), available phosphorus (9.1 kg ha^{-1}) and available potassium (18.1 kg ha^{-1}). The carrot cultivar Nantes was taken for research trial purpose. FYM was applied @ 20 t/ha and spread uniformly in the bed size of 1m x 1m, its quantity was calculated and applied before sowing. Vermicompost procured from the college vermicompost unit was applied in the beds as per treatments and was thoroughly incorporated in to the soil at the time of bed preparation. Vermicompost was @5 t/ha and spread uniformly. Cow urine was drenched @ 20% uniformly in the beds. Application of biofertilizer was done as per treatment. For this 125 g of jaggery was mixed in one litre of boiled water. Appropriate quantity (50 g) of Azotobacter 100 g of culture was poured in jaggery solution separately and stirred well. The seeds were allowed to air dry in shade. The seeds were sown on the same day after inoculation in rows on ridge in each plot. After sowing of seeds a light irrigation was given each plot, to facilitate the germination of seed. Sowing was done as per plan of layout in the morning. All the cultural operations were done at regular intervals as per the requirement of crop during the course of investigation. During the experimentation, from each replication, randomly selected ten plants were used for recording various observations on growth and yield promoting parameters during whole of the cropping period at 30, 60 days after transplanting and at Final harvest stage. The obtained data were statistically analyzed with using standard statistical method as suggested by Gomez and Gomez (1996).

Results and Discussion

The diverse growth as well as yield attributes like plant height, number of leaves, leaf length, fresh weight of plant, dry weight of plant, root length, root diameter, fresh weight of root, dry weight of root, root yield per plot and root yield per hectare were significantly affected by different organic manure treatments as compared to control during the course of examination. The data presented in Table 2 to 5 were showed that the significant enhancement was noticed when applied different combinations of organic manures on carrot as compared to control. The results of the present experimental research were recorded and are thoroughly discussed below:

Table 1: Treatment details

Number of treatment	Combinations	Concentration
T_1	Control	No treatment
T_2	Farmyard manure	20t/ha
T_3	Vermicompost	5t/ha
T_4	Cow urine	20%
T_5	FYM+ Vermicompost + Cow urine	10t/ha + 2.5t/ha+10%
T_6	FYM+ Vermicompost	10t/ha + 2.5 t/ha
T_7	FYM + Cow urine	10t/ha+10%
T_8	Vermicompost + Cow urine	2.5t/ha +10%
T_9	FYM+ Vermicompost + Azotobacter	20t/ha + 5t/ha+5.0kg/ha

Plant height (cm) :

Plant height was recorded at 40, 60, 80 DAS and at harvesting stage. Perusal of data presented in Table 2 and illustrated in Fig. 1 revealed significant response. In general there was increase in plant height up to harvesting stage. Among different treatments, treatment T_9 recorded maximum plant height of (14.55, 31.75, 56.57 and 91.51 cm) at 40, 60, 80 DAS and at harvesting stage, respectively. It was followed by T_7 with a plant height

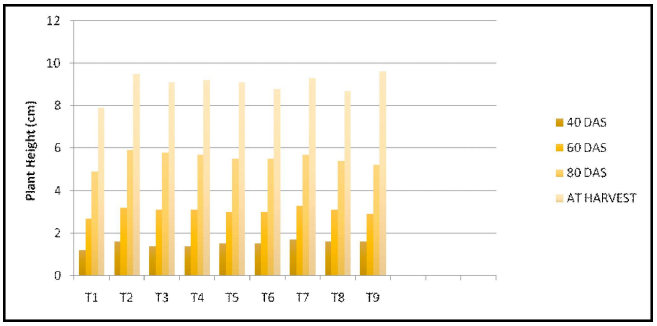

Fig. 1: Plant height (cm) as influenced by organic manure at different harvesting interval in carrot

Table 2: Effect of organic manures treatments on plant height, number of leaves and leaf length of carrot at different harvest intervals

Treatments	Plant height (cm)					Number of leaves					Leaf length (cm)				
	30 DAS	60 DAS	80 DAS	At final harvest	Mean	30 DAS	60 DAS	80 DAS	At final harvest	Mean	30 DAS	60 DAS	80 DAS	At final harvest	Mean
T_1	11.47	25.85	49.61	79.39	28.98	4.33	7.66	15.00	16.33	8.99	10.33	19.74	28.67	58.01	19.58
T_2	12.03	29.07	52.65	82.39	31.25	4.33	9.33	15.33	17.33	9.66	11.71	21.75	35.12	60.9	22.86
T_3	13.31	30.22	55.16	85.39	32.89	4.66	9.66	16.00	18.33	10.11	11.93	23.12	35.71	62.02	23.59
T_4	11.81	26.28	50.16	81.42	29.42	3.66	7.66	15.00	16.66	8.77	11.27	20.53	32.62	58.75	21.47
T_5	12.72	29.27	53.87	83.68	31.95	4.33	8.66	16.00	17.66	9.66	11.86	21.93	37.19	61.24	23.66
T_6	13.78	30.74	55.93	88.34	33.48	3.66	9.66	16.00	18.00	9.77	12.52	23.67	36.14	62.75	24.11
T_7	14.41	32.18	57.80	92.45	34.79	4.00	10.33	17.33	19.33	10.55	13.42	24.51	37.75	64.57	25.23
T_8	13.51	30.47	55.89	87.26	33.29	4.33	11.33	19.33	21.00	11.66	12.26	23.53	33.52	62.52	23.10
T_9	14.55	31.75	56.57	91.51	34.29	3.66	10.00	18.33	20.33	10.66	12.94	24.12	38.50	64.02	25.18
C.D.(P=0.05)			1.633					1.54					2.25		
SE(m) ±			0.764					0.51					0.74		
SE(d) ±			0.540					0.72					1.05		
C.V.			2.899					8.86					5.55		

of (14.41, 32.18, 57.80 and 92.45 cm) at 40, 60, 80 DAS and at harvesting stage, respectively. While minimum plant height (11.47, 25.85, 49.61 and 79.39 cm) was found under T_1 at 40, 60, 80 DAS and at harvesting stage, respectively.

Number of leaves per plant :

Number of leaves plant was recorded in carrot at 40, 60, 80 DAS and at harvesting stage. Perusal of data presented in Table 2 and graphical illustrated in Fig. 2 exhibited significant response of NPK and organic manures on number of leaves plant^{-1} at all the stages in carrot (DAS). Treatment T_8 recorded slightly higher number of leaves plant^{-1} *i.e.* (4.33, 11.33, 19.33 and 21.00) at 40, 60, 80 DAS and at harvesting stage, respectively as compared to other treatments. It was followed by T_9 (3.66, 10.00, 18.33 and 20.33), T_7 and T_3 in descending order at all the stages of growth. While minimum number of leaves *i.e.* (4.33, 7.66, 15.00 and 16.33) per plant were observed under the treatment T_1 at 40, 60, 80 DAS and at harvesting stage, respectively. The carrot plant nourished with organic manures gave maximum values in various growth parameters; this boosted vegetative growth resulting in higher resulting in higher number of green leaves. Similar results have been reported by Azad (2000) in cabbage and Kumar *et al.* (2011) in cauliflower.

Leaf length (cm) :

Length of leaves was noted at 40, 60, 80 DAS and at harvesting stage. Data presented in Table 2 and depicted in Fig. 3 revealed significant results. There was increase in length of leaves with advancement of growth stage up to harvesting stage. Length of leaves of carrot recorded at 40, 60, 80 DAS and at harvesting stage was significantly affected with different treatments. Maximum length of leaves recorded at 40, 60, 80 DAS and at harvesting stage was, respectively under the

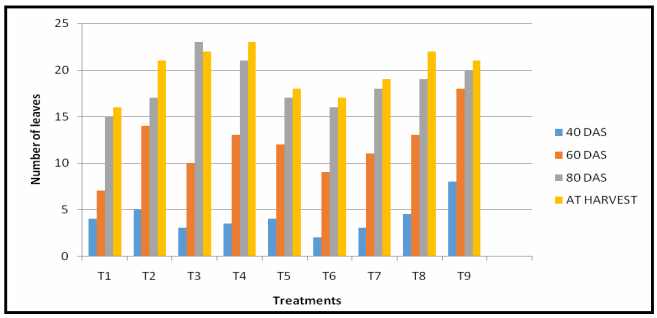

Fig. 2: Number of leaves as influenced by organic manure at different harvesting interval in carrot

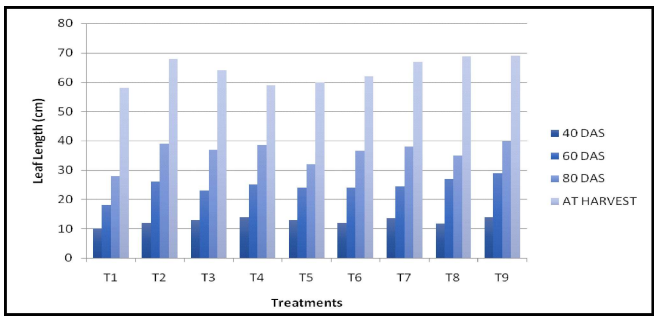

Fig. 3: Leaf length (cm) as influenced by organic manure at different harvesting interval in carrot

treatment T_7 which was statically superior to other treatments. It was followed by T_9 which had recorded (12.94, 24.12, 38.50 and 64.02 cm) length of leaves at 40, 60, 80 DAS and at harvesting stage, respectively. While minimum length of leaves *i.e.* (10.33, 19.74, 28.67 and 58.01cm) were observed under the treatment T_1 (control) at 40, 60, 80 DAS at harvesting stage, respectively. The application of organic manure increases the plant height, number of leaves and leaf length of carrot. These may be due to application of different organic manures in various levels, increased the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants which ultimately improves the plant height. The findings is also in agreement with the findings of Yanthan *et al*. (2012), Jeptoo *et al.* (2013), Kumar *et al.* (2014), Ali *et al.* (2014) and Eric Randy (2016).

Fresh weight of plant (g) :

Fresh weight of plant (g) was recorded at 40, 60, 80 DAS and at harvesting stage. The data presented in Table 2 and depicted in Fig. 4 showed significant response of organic manures on fresh weight of plant (g) at all the stages. Among the nutrient levels, maximum fresh weight of plant (12.24, 63.51, 83.35 and 195.64) was recorded at 40, 60, 80 DAS and at harvesting stage, respectively under the nutrient level T_7. It was followed by (12.02, 62.37, 82.32 and 192.61) in T_9, (11.76, 58.58, 78.37 and 188.77) in T_6 in descending order at all the growth stages under study. While minimum fresh weight of plant *i.e.* (7.5, 50.54, 70.56, and 170.33 g) was observed under the treatment T_1 (control) at 40, 60, 80 DAS and at harvesting stage, respectively.

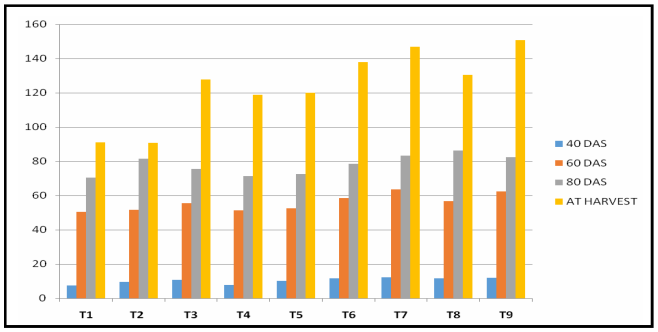

Fig. 4 : Fresh weight of plant (g) as influenced by organic manure at different harvesting interval in carrot

Dry weight of plant (g) :

Dry weight of plant was recorded at 40, 60, 80 DAS and at harvesting stage. The data presented in Table 3 and depicted in Fig. 5 showed significant response of organic manures on dry weight of plant at all the stages. Dry weight of plant recorded at 40, 60, 80 DAS and at harvesting stage was significantly affected with different nutrient levels. The maximum dry weight of plant, recorded at 40, 60, 80 DAS and at harvesting stage was under the T_7. It was followed by T_9 which registered a dry weight of plant (1.25, 8.52, 19.51 and 29.51 g) at 40, 60, 80 DAS and at harvesting stage, respectively, while minimum dry weight of plant *i.e.* (0.88, 5.12, 15.48 and 27.13 g) were recorded under the nutrient level T_1 (control) at 40, 60, 80 DAS and at harvesting stage, respectively.

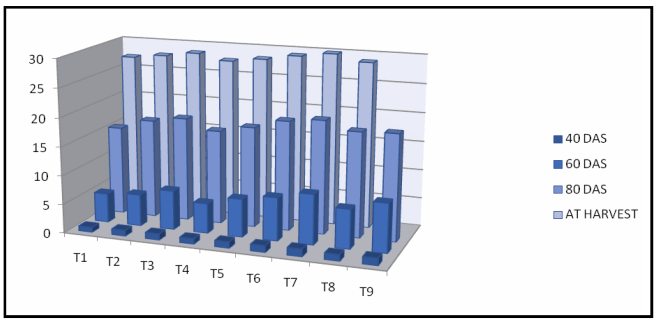

Fig. 5: Dry weight of plant (g) as influenced by organic manure at different harvesting interval in carrot

Root length (cm) :

Length of root (cm) in carrot was observed at harvesting stage. The data presented in Table 3 exhibited significant influence of organic manures on length of root in carrot. Length of root in carrot was significantly affected with different treatments. Maximum length of root (28.00cm) was observed under the treatment T_4. It was significantly superior over other treatments. Rest of the treatments were in an order of (27.00cm) in T_3 and (26.96) in T_9. While minimum length of root *i.e.* 21.62 cm was observed under the treatment T_1 (control) after harvesting.The size of root was directly influenced by the enhanced vegetative growth of the plants resulting in increased height and number of leaves. This might have accumulated more carbohydrates, resulting increased diameter of the root, which is food storage organ as reported by Bhandari *et al.* (2012).

Root diameter (cm):

Diameter of root (cm) in carrot was recorded at harvesting stage. Perusal of data presented in Table 4 exhibited significant influence of organic manures on diameter of root in carrot. Diameter of root in carrot was significantly affected with different treatments.

Table 3: Effect of organic manures treatments on fresh weight of plant, dry weight of plant and root length of carrot at different harvest intervals

Treatments	Fresh weight of plant (g)					Dry weight of plant (g)					Root length (cm)				
	30 DAS	60 DAS	80 DAS	At final harvest	Mean	30 DAS	60 DAS	80 DAS	At final harvest	Mean	30 DAS	60 DAS	80 DAS	At final harvest	Mean
T_1	7.51	50.54	70.56	170.33	42.87	0.88	5.12	15.48	27.13	7.16	9.95	15.60	18.25	21.62	14.600
T_2	9.42	51.56	81.37	155.75	47.45	1.03	5.56	17.25	27.76	7.95	12.50	18.60	20.09	22.54	17.06
T_3	10.60	55.45	75.42	183.70	47.15	1.103	6.86	18.12	28.53	8.69	15.71	21.99	24.30	27.00	20.67
T_4	7.75	51.26	71.36	172.65	43.45	0.95	5.25	16.40	27.53	7.53	18.70	22.00	26.70	28.00	22.47
T_5	10.12	52.53	72.43	180.66	45.02	1.12	6.66	17.53	28.20	8.44	14.10	20.99	23.15	25.22	19.41
T_6	11.76	58.58	78.37	188.77	49.57	1.18	7.55	19.12	29.13	9.28	14.00	20.30	22.15	24.66	18.82
T_7	12.24	63.51	83.35	195.64	53.03	1.33	8.76	19.76	29.86	9.95	15.20	21.50	24.10	26.00	20.27
T_8	11.54	56.62	86.35	185.38	51.50	1.13	6.86	18.31	28.76	8.77	13.31	17.15	21.02	23.88	17.16
T_9	12.02	62.37	82.32	192.61	52.23	1.25	8.52	18.51	29.51	9.43	16.00	21.75	24.50	26.96	20.75
C.D.(P=0.05)			5.61					1.27					1.18		
SE(m) ±			1.68					0.42					0.39		
SE(d) ±			2.37					0.59					0.55		
C.V.			6.04					8.5					3.54		

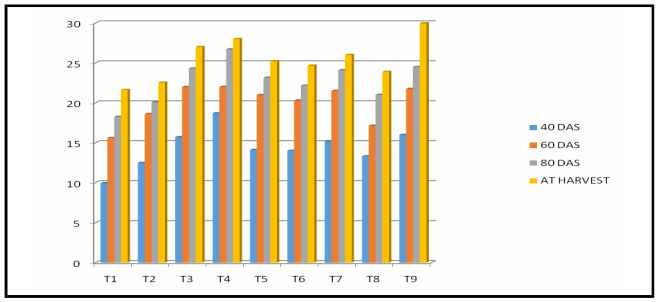

Fig. 6: Root length (cm) as influenced by organic manure at different harvesting interval in carrot

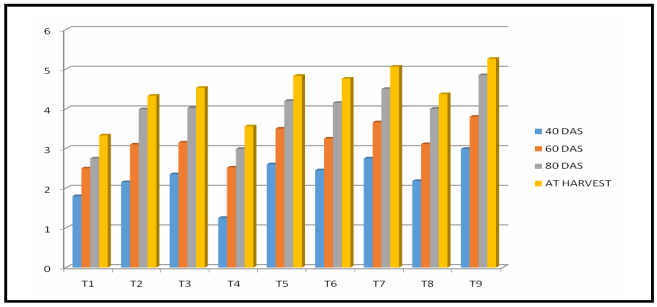

Fig. 7 : Root diameter (cm) as influenced by organic manure at different harvesting interval in carrot

Maximum diameter of root (5.26cm) was observed under the treatment T_9 which was followed by (5.06cm) in T_7), (4.83cm) in T_5 in descending order. Minimum diameter of root (3.33 cm) was recorded under the treatment T_1 (control). Yadav *et al.* (2003) indicated that application of vermicompost along with other organic manures increased the root volume or width in chilli. Decrease in bulk density and increase in porosity and water holding capacity of the soil due to organic manures might have contributed in increasing the root volume of the plants.

This might be due to the fact that combined application of vermicompost and Azotobacter helped in increasing number of leaves, expansion of leaf area and chlorophyll content which together might have accelerated the photosynthetic rate and in turn increased the supply of carbohydrates to the plants.

Fresh weight of root (g) :

Fresh weight of root (g) was recorded at harvesting stage. Perusal of data Table 4 exhibited significant influence of organic manures on fresh weight of root in carrot. Fresh weight of root in carrot was significantly affected with different nutrient levels. Maximum fresh weight of root (121.48 g) was noted under the nutrient level T_9 followed by (120.70g) in T_7. Minimum fresh weight of root (102.86 g) was observed under the T_1 (control).

Dry weight of root (g) :

The data presented in Table 4 showed significant influence of variety and nutrient levels on dry weight of root in carrot. Dry weight of root (g) in carrot was significantly affected with different nutrient levels. Maximum dry weight of root (8.45g) was found under the nutrient level T_7 which was significantly superior over all other nutrient levels. Rest of the nutrient levels were in the order of (7.47g) in T_9, (7.40g) in T_6 in descending order. While, minimum dry weight of root (4.94 g) was observed under the nutrient level T_1 (control).

Table 4: Effect of organic manures treatments on fresh weight of plant, dry weight of plant of carrot at different harvest intervals

Treatments	Root diameter (cm)					Fresh weight of root (g)					Dry weight of root (g)				
	30 DAS	60 DAS	80 DAS	At final harvest	Mean	30 DAS	60 DAS	80 DAS	At final harvest	Mean	30 DAS	60 DAS	80 DAS	At final harvest	Mean
T_1	1.8	2.50	2.75	3.33	2.35	39.05	65.00	80.00	106.86	61.35	3.53	3.99	4.45	4.94	3.99
T_2	2.15	3.10	3.99	4.33	3.08	42.55	71.15	92.09	112.53	68.59	3.80	4.25	4.99	5.36	4.35
T_3	2.35	3.15	4.02	4.53	3.17	50.15	74.47	95.55	118.52	73.39	5.55	6.15	6.77	7.13	6.16
T_4	1.25	2.52	2.99	3.56	2.25	40.50	65.25	80.20	107.39	61.98	3.55	4.00	4.60	5.12	4.05
T_5	2.60	3.50	4.20	4.83	3.43	59.95	79.95	97.15	120.15	79.02	5.75	6.35	6.95	7.28	6.35
T_6	2.45	3.25	4.15	4.76	3.28	50.25	75.25	95.50	119.78	73.66	5.99	6.55	7.05	7.40	6.53
T_7	2.75	3.66	4.50	5.06	3.64	60.50	80.00	97.20	120.70	79.23	7.05	7.45	8.09	8.45	7.53
T_8	2.18	3.11	4.00	4.37	3.09	49.77	75.01	95.40	118.52	73.39	5.01	5.60	6.20	6.78	5.60
T_9	2.99	3.80	4.85	5.26	3.88	69.15	85.00	105.50	121.48	86.55	6.15	6.75	7.10	7.47	6.67
C.D.(P=0.05)			0.29					4.77					0.13		
SE(m) ±			0.09					1.58					0.04		
SE(d) ±			0.14					2.23					0.06		
C.V.			5.32					3.74					1.29		

Root yield (Kg/plot) :

The mean performance of root yield per plot of different treatments of organic manure has been presented in Table 5. The yield of root per plot was significantly increased due to different treatment of organic manures. The average root yield per plot was ranged from 4.09 to 12 kg. The highest root yield per plot was recorded under the treatment T_9 (12kg) followed by (10.9 kg) in T8 which is at par with T_7. However, the lowest root yield per plot was observed in the treatment T_1 (4.09kg). These findings are in conformity with those of Patil *et al*. (2007) in onion, Dhananjaya, (2007) and Singh *et al*. (2012) in garlic. They found that combined applicable of organic manure and bio-fertilizers increased the yield attributes and finally the total yield in garlic. Later on it was also supported by the findings of Kumar *et al.* (2012) in garlic, Shinde *et al*. (2013) in onion, Jeptoo *et al*. (2013) in carrot, Jadhav *et al*. (2014), Ziaf *et al*.(2015) and Khalid *et al.* (2015).

Root yield (q/ha) :

Yield of root (q/ha) was recorded after harvesting. The data presented in Table 5 exhibited significant response of organic manures on root yield in carrot. The highest root yield (435.44 q/ha) was recorded under the treatment T_9 which is at par with T_7 (435.30 q/ha). It was followed by 350.94 q/ha in T_5 and 344.33 q/ha in T_6 in descending order. While, lowest root yield of (115.33 q/ha) was observed under the treatment T_1 (control). The application of organic manure and bio-fertilizers significantly increased the yield parameters. Hiranmai *et al.* (2003) reported that fresh weight of plants was higher in vermicompost and NPK in chilli. The increase in fresh weight of leaves, roots and whole plant may be due to higher level of nitrogen from vermicompost and bio-fertilizers. The nitrogen will also be synthesized into amino acids which are built into complex proteins and help in promoting the luxurious growth of crop.

Table 5: Effect of different organic manures on yield attributes of carrot

Treatment	Root yield (Kg/plot)	Root yield (q/ha)
T_1	4.09	115.33
T_2	8.52	220.10
T_3	9.66	255.50
T_4	9.78	150.11
T_5	9.86	350.94
T_6	10.00	344.33
T_7	10.50	435.30
T_8	10.99	177.50
T_9	12.00	435.44
C.D.(P=0.05)	2.40	0.11
SE(m) ±	0.79	0.036
SE(d) ±	1.12	0.051
C.V.	4.61	0.023

Conclusion :

On the basis of present research on "Effect of organic manure on growth and yield of carrot (*Daucas carota* L.) under low hills of Uttarakhand in cv. Nantes

it can be concluded that among all, the organic treatment with Farmyard Manure (100%) + Vermicompost (100%) + Azotobacter (5.0 Kg/ha) *i.e.* T_9 has sown the significant improvement in growth and yield parameters than other treatments. The treatment recorded highest plant height (cm), number of leaves per plant, leaf length (cm), leaf width (cm), root length (cm), root diameter (cm), fresh weight of root (g), dry weight of root (g) and root yield (kg/plot) as well as root yield (q/ha).

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