Report on Radish
by GKVK,Bengaluru

Summary

Effect on Growth Parameters of Plants	Jiva Water (T1)	Normal Water (T2)	% Increase
Root Length on Maturity (cms)	18.21	13.60	33.9
Plant size on maturity (cms)	24.54	20.50	19.70
Leaves count per plant on maturity	10	8.71	14.81
Maturity period in days	37	40	6.5
Yield (Mt/Hectare)	47.12	27.50	71
Ascorbic Acid content in Radish (mg/kg)	32.49	30.67	5.93

%age increase in nutrient content	Jiva Water (TI)	Normal Water (T2)
Nitrogen Content in Soil (Kg/Hectare)	10	5.754
Phosporous content in soil (Kg/Hectare)	1.83	0.92
Potassium content in soil (Kg/Hectare)	2.63	0.35

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Impact of JIVA Water versus Regular Water on Crops like Radish and Maize on Crop Performance and Soil Health

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CONTENTS

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1. Introduction

Water is a critical resource in agriculture, directly influencing crop performance and soil health. In recent years, the quality of irrigation water has garnered increasing attention due to its significant impact on agricultural productivity and sustainability. JIVA Water is engineered to mimic the natural properties of pristine water sources, claiming benefits such as improved nutrient uptake, enhanced soil structure, and increased crop yields. These properties are purportedly achieved through a process that restructures the water at a molecular level, potentially leading to better hydration and nutrient absorption by plants. Radish was chosen for this study because they are fast-growing root vegetables with a relatively short cultivation period, making them ideal for observing quick changes in growth parameters. In addition to crop growth and yield, soil health is a crucial component of sustainable agriculture. Healthy soil is vital for maintaining productive agricultural systems, as it supports plant growth, regulates water, and sustains biological activity. This study will also assess the impact of JIVA Water on soil health indicators such as microbial activity and nutrient availability. By comparing the effects of JIVA Water and regular water on radish this research aims to provide a scientific basis for the potential benefits of structured water in agriculture. The findings could offer valuable insights for farmers and agricultural stakeholders seeking sustainable and efficient water management practices, ultimately contributing to improved crop performance and soil health.

2. Materials and Methods

The study was conducted during February- April 2024 at GKVK, Bengaluru. The experiment was laid out in Randomized Complete Block Design (RCBD) with two treatments replicated fourteen times. The treatments include T_1: JIVA water and T_2: Normal water. The land was ploughed with tractor drawn mould board plough followed by harrowing and levelling. The field was cleaned by removing the weeds, stubbles and crop residues. Deep ploughing was done with a tractor drawn disc plough and later cultivator was passed to crush the clods, then harrowing was done twice with the blade harrow to achieve fine tilth for sowing. The layout was made according to the experimental design and plot size for sowing of seeds. FYM and fertilizers were applied as per the POP. The furrows were made at a distance of 30 cm between the rows as per the treatment by using marker. The spacing between plants to plant was maintained at a distance of 10 cm. The seeds were dropped within the furrow at a depth of not more than 5cm, two seeds were sown per $hill^{-1}$ and covered with soil on 22nd February 2024. After the emergence of seedlings, thinning operation was carried out at 15 DAS by leaving only one healthy and normal seedling per hill to maintain a distance of 10 cm

between plants in a row. The experimental plot was irrigated using surface drip irrigation system immediately after sowing for better and uniform germination. Subsequently the irrigations were given at different interval depending up on soil moisture content and seasonal condition using surface drip installed at different intervals. Uniform soil moisture was maintained throughout the crop growth period. On a regular basis the experimental plots were kept weed-free by hand weeding without the application of pre- or post-emergence herbicides. After reaching physiological maturity, the crop was harvested plot by plot at intervals of 4-5 days. The first harvest was conducted on 29/03/2024 in treatment T_1 and the last harvest was during 19/04/2024. The harvesting started from 1/04/2024 and lasted till 18/04/2024 in treatment T_2. Harvesting was done when the soil moisture was optimum. The plants were pulled out without damaging the roots from the net plot and gross plot separately and the soil adhering to the roots was removed.

Randomly five plants from each plot were selected to record the data on various parameters. The materials and methods followed is mentioned below:

Growth and yield parameters

Plant height – Height of randomly selected and labelled plants was recorded at 30 DAS and at last harvest by measuring from the ground level to the tip of the top leaf and mean values are expressed in cm.

Number of leaves per plant- The number of leaves at 30 DAS and at last harvest were counted from randomly selected and labelled plants and average was worked out.

Leaf Length- The length of the leaves was recorded at 30 DAS and at last harvest by measuring the length of the longest leaf and the means were worked out and expressed in cm.

Leaf width-The widest point in the middle portion of matured leaf was calculated and expressed in cm.

Root length-The root length of five randomly selected and labelled plants was recorded at last harvest and mean values were calculated.

Days taken for maturity-The number of days taken from the date of sowing to the day taken for maturity was recorded and expressed in days.

Vegetable yield-The yield was recorded treatment wise from each net plot at different intervals and expressed as yield per hectare in tons.

Vegetable quality analysis

Vitamins- The ascorbic acid content of fresh ripen fruits was determined using 2, 6- dichlorophenol indophenol dye method (Sadasivam and Manickam, 1996) and was expressed as mg 100 g^{-1}.

Plant chemicals Analysis

The N, P, K and micronutrients content were analyzed by standard procedures. N content was determined by distillation and titration method (Jackson, 1973). Diacid digestion of plant sample was done to determine the P content by Vanadomolybdo phosphoric yellow colour method (Jackson, 1973). K content in diacid digest was estimated using flame photometer (Jackson,1973). The micro nutrient content was estimated using AAS. The uptake of N, P, K and micro nutrients were calculated as the product of the content of these nutrients and the plant dry weight and expressed in kg ha^{-1}.

Soil sample Analysis (Initial and at harvest)

Soil samples collected from the experimental plots before and after the experiment were processed and subjected for analysis of various chemical properties.

Soil pH and Electrical conductivity (dSm^{-1})-Soil pH was measured in 1:2.5 soil: water suspension, using pH meter (Jackson, 1967). For electrical conductivity the clear supernatant solution of the above soil – water suspension was taken out and the electrical conductivity was measured using Conductivity bridge (Jackson, 1967).

Organic carbon- Organic carbon was estimated by Walkley and Black's wet oxidation method as described by Jackson (1973).

Cation exchange capacity- Cation exchange capacity of initial soil samples was determined by ammonium acetate method (Jackson, 1958). The residue was washed to remove unabsorbed ammonia by leaching with alcohol and later adsorbed ammonia was replaced by K^+ ion and the leachate was distilled to estimate the adsorbed ammonia.

Available Nitrogen- The available nitrogen (kg ha) of soil was determined by alkaline potassium permanganate method as outlined by Subbaiah and Asija (1956).

Available Phosphorus- Available phosphorus in the soil was extracted using the Bray extractant method. The extracted phosphorus was then measured using the ascorbic acid blue colour method. The intensity of the blue colour was read with a spectrophotometer at a wavelength of 660 nm.

Available potassium-Available potassium was extracted from the soil using a neutral normal ammonium acetate solution. The potassium in the extract was then measured with a flame photometer.

Micronutrients (Fe, Zn, Cu, Mn)- The available soil iron, zinc, manganese, and copper were determined by shaking the soil with a DTPA extractant solution (0.005 M DTPA + 0.01 M $CaCl_2 \cdot 2H_2O$ + 0.1 M TEA, pH > 7.3) at a 1:2 soil-to-extractant ratio. The mixture was then filtered, and the filtrate was analyzed using Atomic Absorption Spectrophotometer (AAS).

3. Results

Water quality parameters

Parameter	JIVA water	Normal water
pH	7.79	7.54
EC (dSm^{-1})	0.34	0.34
RSC	0.65	0.70
Chloride ($mg\ l^{-1}$)	810	812

Growth attributes

Growth attributes of radish such as plant height, number of leaves, leaf length and leaf width were significantly influenced by treatments as shown in Table 1. Plant height was highest in T_1 at harvest but was non-significant at 30 DAS. Number of leaves was highest in T_1 at 30DAS and at Harvest compared to T_2. Leaf length and leaf width followed similar trend at 30 DAS whereas at harvest leaf width was non-significant. Root length was non-significant at 30DAS whereas it was significantly influenced by treatments at harvest. Treatment T_1 recorded higher root length at harvest.

Table 1: Effect of treatments on growth attributes

tments	Plant Height (cm)		Number of leaves per plant		Leaf length (cm)		Leaf Width (cm)		Root length (cm)	
	30 DAS	At Harvest	30 DAS	At Harvest	30 DAS	At Harvest	30 DAS	At Harvest	30 DAS	At Harvest
T_1	14.92	24.54	5.21	10.00	24.64	32.08	7.95	11.60	8.28	18.21
T_2	13.50	20.50	4.35	8.71	22.30	30.32	6.60	10.60	7.42	13.60
E (m) ±	0.43	0.41	0.25	0.28	0.39	0.44	0.25	0.32	0.30	0.53
(P=0.05)	NS	1.62	0.55 •	0.86	1.53	1.74	0.78	NS	NS	1.62

Yield attributes

Days taken to maturity was non-significant even though T_1 obtained less number of days to mature compared to T_2. Vegetable yield was significantly influenced by the treatments. T_1 recorded significantly higher yield at harvest compared to T_2 (Table 2).

Table 2: Effect of treatments on yield parameters

Treatments	Days taken to maturity (days)	Vegetable yield (t ha^{-1})
T1	**37.50**	47.12
T2	**40.00**	27.50
SE (m) ±	**0.35**	1.01
CD (P=0.05)	**NS**	3.97

Vegetable quality analysis

Ascorbic acid content was anlysed in radish but was non-significant as shown in Table 3.

Table 3: Effect of treatments on quality parameters

Treatments	Ascorbic acid content (mg kg^{-1})
T_1	32.49
T_2	30.67
SE (m) ±	0.58
CD (P=0.05)	NS

Plant chemical Analysis

N content and their uptake was significantly influenced by the treatments as shown in Table 4 and 5. T_1 recorded higher N content and uptake compared to T_2. P, K, Micronutrient content and uptake was not significantly influenced by treatments.

Table 4: Effect of treatments on nutrient content in radish

eatments	N content (%)	P content (%)	K content (%)	Mn content (mg kg^{-1})	Copper content (mg kg^{-1})	Zinc content (mg kg^{-1})	Iron content (mg kg^{-1})
T_1	7.21	0.50	5.08	1.17	1.33	7.45	11.16
T_2	6.03	0.46	4.96	1.15	1.18	7.31	11.04
SE (m) ±	0.13	0.03	0.14	2.63	0.25	0.67	1.13
D (P=0.05)	0.51	NS	NS	NS	NS	NS	NS

Table 5: Effect of treatments on nutrient uptake in radish

atments	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	Mn uptake (g ha^{-1})	Copper uptake (g ha^{-1})	Zinc uptake (g ha^{-1})	Iron uptake (g ha^{-1})
T_1	65.88	6.68	68.74	22.64	0.66	1.60	7.56
T_2	59.78	5.84	67.62	22.02	0.62	1.57	7.44
SE (m) ±	1.14	0.22	0.42	0.44	0.02	0.01	0.05
D (P=0.05)	4.48	NS	NS	NS	NS	NS	NS

Soil Analysis

In the soil analysis, pH, EC, CEC, Available micro nutrients was not significantly influenced, whereas available N, P and K was significantly influenced by treatments (Table 6 and 7)

Table 6 : Effect of treatments on soil chemical analysis

Treatments	pH	EC (dsm^{-1})	CEC ($cmol\ kg^{-1}$)	OC (%)	Available N ($kg\ ha^{-1}$)	Available P ($kg\ ha^{-1}$)	Available K ($kg\ ha^{-1}$)
Initial	5.86	0.05	6.56	0.21	221.45	150.65	112.56
T_1	5.97	0.06	6.53	0.21	243.58	153.41	115.53
T_2	5.89	0.05	6.51	0.21	234.18	152.04	112.96
SE (m) ±	0.11	0.002	0.02	0.015	0.83	0.25	0.50
CD (P=0.05)	NS	NS	NS	NS	3.28	0.96	1.97

Table 7 : Effect of treatments on soil micronutrient availability

Treatments	Avail. Mn ($mg\ kg^{-1}$)	Avail. Copper ($mg\ kg^{-1}$)	Avail. Zinc ($mg\ kg^{-1}$)	Avail. Iron ($mg\ kg^{-1}$)
	Initial-10	Initial-1.13	Initial-2.13	Initial-13.13
T_1	13.90	1.29	2.41	16.83
T_2	10.00	1.15	2.16	13.49
SE (m) ±	1.01	0.04	0.07	0.86
CD (P=0.05)	NS	NS	NS	NS

Conclusion

Growth and yield attributes of radish such as plant height, number of leaves, leaf length, leaf width, root length and vegetable yield were significantly higher in the treatment T_1 compared to T_2. Plant height, root length at 30DAS and leaf width at harvest was non-significant. Plant nitrogen content and uptake recorded was significantly higher in the treatment T_1 compared to T_2. Soil parameters such as available nitrogen, phosphorus and potassium was significantly higher in the treatment T_1 and was lower in treatment T_2. The analyzed parameters such as days taken to maturity, ascorbic acid content, phosphorus, potassium, manganese, copper, zinc, iron, content and their uptake, soil pH, electrical conductivity, cation exchange capacity, organic carbon, available manganese, copper, zinc and iron was non-significant. Even though treatment T_1 was higher compared to T_2 in all the parameters analyzed.

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