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# Effect of Different Water Resources on Yield and Growth Attributes of Kale *(Brassica Oleracea* Var. Acephala L.) in Kashmir

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**Abstract**

A field experiment was carried out at Experimental Farm, SKUAST-Kashmir, Shalimar campus to study the "Effect of different water resources on yield and growth attributes of kale (*Brassica oleracea* var.acephala L.) in Kashmir". The experiment was laid out in Randomized Complete Block Design with five replications. The experiment comprised of four treatments viz., $T_1$: Untreated sewage water, $T_2$: Treated sewage water, $T_3$: Tube-well water and $T_4$: Shalimar stream water (control). Observations were recorded on various aspects like yield and growth attributes of kale. The results show that plant fresh weight (297.95 g), dry weight (51.10 g), root length (11.74 cm), shoot length (42.52 cm) and total chlorophyll (3.11 mg/g) were higher in the plots treated with $T_1$ as compared to $T_4$ (control). The study concludes with the findings that application of $T_1$ (untreated sewage water) followed by $T_2$ (treated sewage water) exhibited higher yield in kale.

**Key words**: Soil fertility, Heavy metals, Kale, Sewage sludge, Water quality.

## Introduction

Sewage effluent is inevitable by-product of water bodies and wastewater treatment plants. Sewage effluent is considered to be a source of organic matter and plant nutrients including soluble salts and heavy metals like Fe, Cu, Zn, Ni (Sadiq et al. 2005 and Arora et al. 2008). Application of sewage effluents to agricultural soils has become a promising and rational use.

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

Irrigation is an excellent user for sewage effluent consumption because sewage effluent is mostly water with nutrients. Using wastewater for irrigation is unrestricted provided it has no adverse effects on crops, soils, animals and humans (Raeisi-Vanani et al. 2017). Reclamation of wastewater for irrigation after treatment represents a challenge that could alleviate pressure on water resources and address the increasing demand for agriculture (Courault et al. 2017). Many studies have demonstrated the benefits of sewage effluent utilization by increasing the soil organic carbon and cation-exchange capacity (Melo et al. 1994), improvement of soil physical characteristics (Jorge et al. 1991), as a source of nutrients, particularly nitrogen and phosphorus (Biscay and Miranda, 1996).

The use of sewage sludge as organic fertilizers not only increases yields of different crops but is also being promoted as an eco-friendly and sustainable solution for soil fertility and reducing the usages of synthetic fertilizers (Dar et al. 2019). This study was conducted in order to determine the effects of different doses of treated and untreated sewage along with irrigation water mainly tube wells on yield and some growth parameters of kale (*Brassica oleracea* var. acephala L.).

**Material and Methods**

**Study area:** The investigation was conducted at Experimental Farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar which is situated 16 km away from city centre that lies between $34^{o}.8'$ N latitude and $74^{o}$ $83'$ E longitude at an altitude of 1587 meters above mean sea.

**Experimental design:** The experiment was laid in a randomized complete block design with five replications, in 20 plots, each measuring (1 × 1.5m). The plants were irrigated, in accordance with their water demand. The water level was made up as and when required. Each plot was randomly assigned to receive one of four treatments as follows:

$T_1$: Untreated STP Water, $T_2$: Treated STP Water, $T_3$: Tube well Water and $T_4$: Shalimar Stream Water (Control)

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

**Water resources used:** Water was taken from a sewage treatment plant situated at Hazratbal area. Both untreated and treated sewage water were taken in 500 litre water tank, which were then transported to SKUAST-K Experimental Farm. These two served as source $1^{st}$ and $2^{nd}$. Source $3^{rd}$ included Shalimar tube-well water. Source $4^{th}$ included the control water which was Shalimar stream water flowing inside Shalimar campus.

**Growth and yield parameters**

**Root length:** Root lengths (cm) of 4 randomly selected roots were taken. Average was calculated and expressed as root length in centimetres.

**Shoot length:** Shoot length was estimated on randomly selected 4 shoots. Average was calculated and expressed in centimetres.

**Fresh and dry weight of plant:** Plant samples of kale collected at harvest from each plot were weighed in fresh for fresh weight (expressed in grams) and then dried in shade for 24-48 hours and then oven dried at 60-65 $^{o}$C for 48 hours to a constant weight. The dried weight was then recorded in grams.

**Yield:** Yield/plant in grams, yield/plot in kilograms and yield/ha in kilograms were calculated with the help of fresh weight of plant and converted into ha for expressing yield in (kg/ha).

**Photosynthetic pigment content:** The contents of chlorophyll *a*, chlorophyll *b*, total chlorophyll and carotenoids were determined according to the method given by Hiscox and Isrealstam (1979) using dimethyl sulphoxide (DMSO).

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

**Crop attaining full vegetative growth**

## Results and Discussion

### Morphological attributes of kale:

The data regarding the effect of different sources of irrigation water on morphological characteristics viz. root length, shoot length (in cm), fresh weight and dry weight (in grams) of kale is presented in Table 1 and Fig.1. The root length was found higher in kale cultivated under untreated sewage water (11.74 cm) followed by treated sewage water (9.93 cm) and tube well water (8.41 cm) as compared to root length in kale cultivated under Shalimar stream water (7.69 cm). The shoot length was found to be higher in kale cultivated under untreated sewage water (42.52 cm) followed by treated sewage water (38.34 cm) and tube well water (36.07 cm) as compared to shoot length in kale cultivated under control (27.54 cm). The fresh weight was found higher in kale cultivated under untreated sewage water (297.95 g) followed by treated sewage water (259.88 g) and tube well water (234.00g) as compared to the fresh weight in kale cultivated under control (198.57 g). Table 1 and Fig. 2 also reveals that the dry weight of kale grown in untreated sewage water, treated sewage water and tube well water was recorded maximum (51.10 g, 40.33 g and 36.24 g) and minimum dry weight was recorded in kale grown under control (25.27 g). An improvement in fresh and dry weight of plants is the reflection of

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

increased root length as also observed in the present study and may be due to application of untreated sewage water containing good amount of plant growth nutrients. In fact nitrogen, an important component of NPK fertilizers, is also a constituent of plant tissue involved in cell division and elongation thereby improving both root and shoot length of plant in kale. Dar et al. (2019) reported that the growth parameters of kale were increased significantly with increased application of nitrogen. Uttara et al. (2018) found that the aboveground biomass, belowground biomass, total biomass and root/shoot ratio was greater in sewage irrigated wheat crops than those grown at control site (tube well irrigated site).

Table 1: Effect of different water resources on morphological characteristics of kale

| **Parameters** / **Treatments** | **Root length (cm)** | **Shoot length (cm)** | **Fresh weight of plants (g)** | **Dry weight of plants (g)** |
|---|---|---|---|---|
| $T_1$: Untreated sewage water | 11.74 | 42.52 | 297.95 | 51.10 |
| $T_2$: Treated sewage water | 9.93 | 38.34 | 259.88 | 40.33 |
| $T_3$: Tube-well | 8.41 | 36.07 | 234.00 | 36.24 |
| $T_4$:Shalimar stream (Control) | 7.69 | 27.54 | 198.57 | 25.27 |
| C.D. ($p \leq 0.05$) | 0.744 | 1.101 | 2.584 | 1.239 |

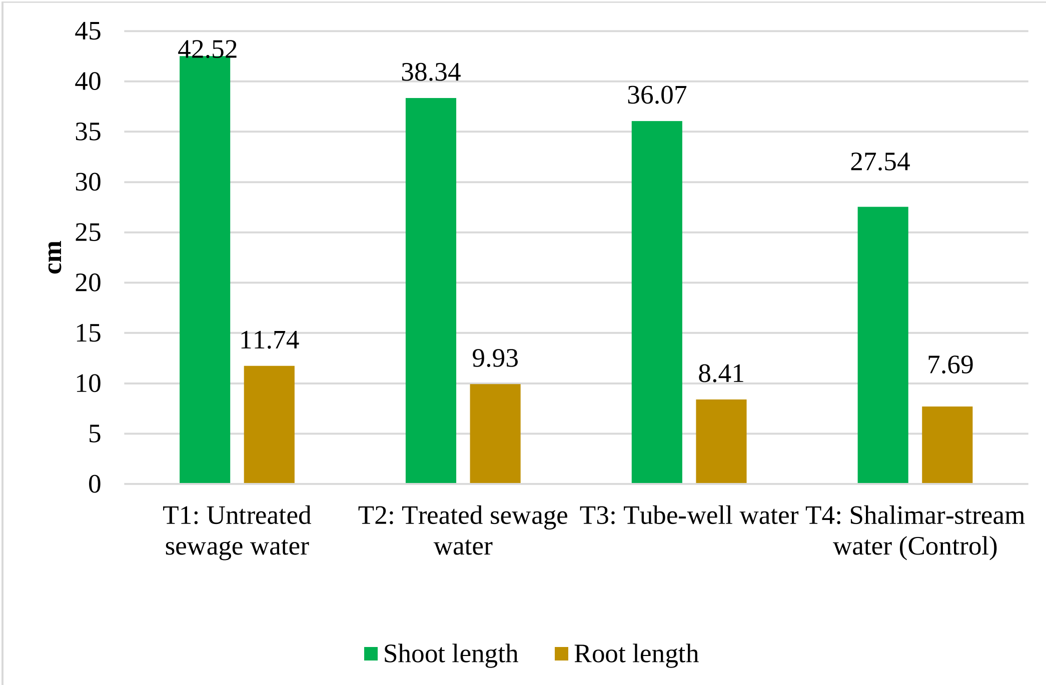


Fig. 1: Effect of different water resources on morphological characteristics of kale (root and shoot length)

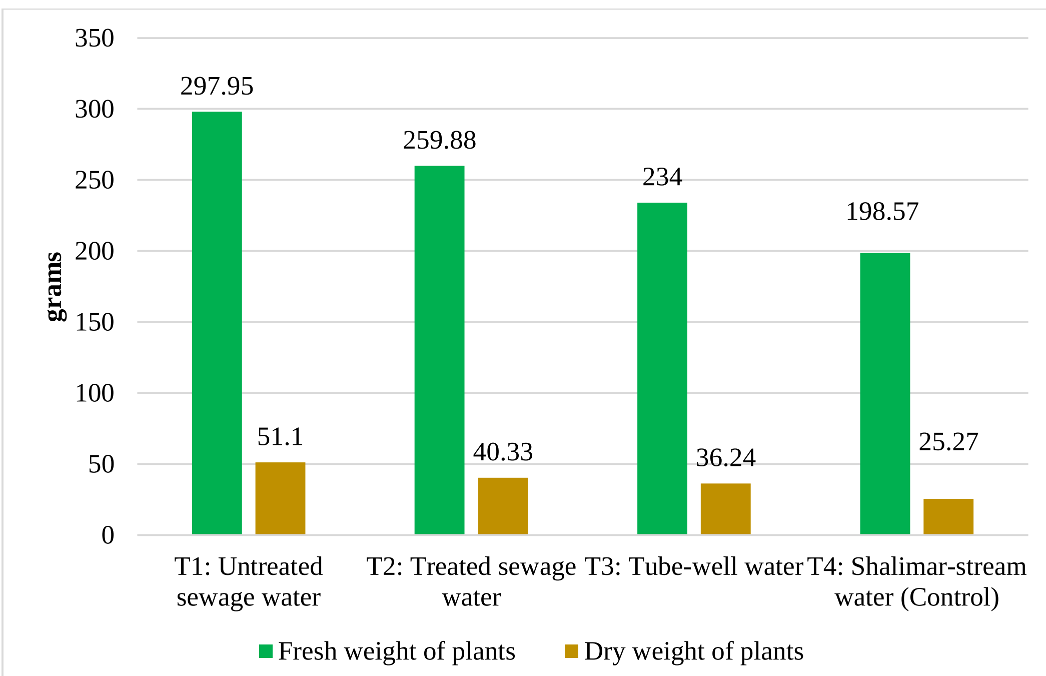


Fig. 2: Effect of different water resources on morphological characteristics of kale (fresh weight and dry weight of plants)

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

**Yield characteristics of kale**

The results on the effect of different sources of irrigation water on yield parameters of kale are present in Table 2. It is inferred from the data that in kale, maximum yield was observed under the application of untreated sewage water (23,813 kg/ha), treated sewage water (20,746 kg/ha) and tube well water (18,680 kg/ha), whereas, the minimum yield was obtained under the control treatment (15,853 kg/ha). The yield in terms of kg/ha was statistically higher in all the treatments as compared to control treatment (Table 2 and Fig. 3). Irrigation with untreated sewage water showed a marked increase in yield pertaining to kale. Higher yields under waste water irrigated plots can be explained by higher available nutrient accumulation under untreated sewage water irrigated plot. The findings are in conformity with the earlier studies reported by Sahay et al. (2013) on Brassica cultivars. Higher yield in the wheat crop was observed by Uttara et al. (2018) when wheat crops were irrigated with sewage water as compared to those irrigated with tube well water (control). Similar findings were found by Shilpi et al. (2018).

Table 2: Effect of different water resources on yield parameters of kale

| Parameters / Treatments | Yield/plant (g) | Yield/plot (kg) | Yield/ha (kg) |
|---|---|---|---|
| $T_1$: Untreated sewage water | 297.95 | 3.57 | 23,813 |
| $T_2$: Treated sewage water | 259.88 | 3.11 | 20,746 |
| $T_3$: Tube-well | 234.00 | 2.80 | 18,680 |
| $T_4$: Shalimar stream (Control) | 198.57 | 2.37 | 15,853 |
| C.D. ($p \leq 0.05$) | 2.584 | 0.031 | 205.18 |

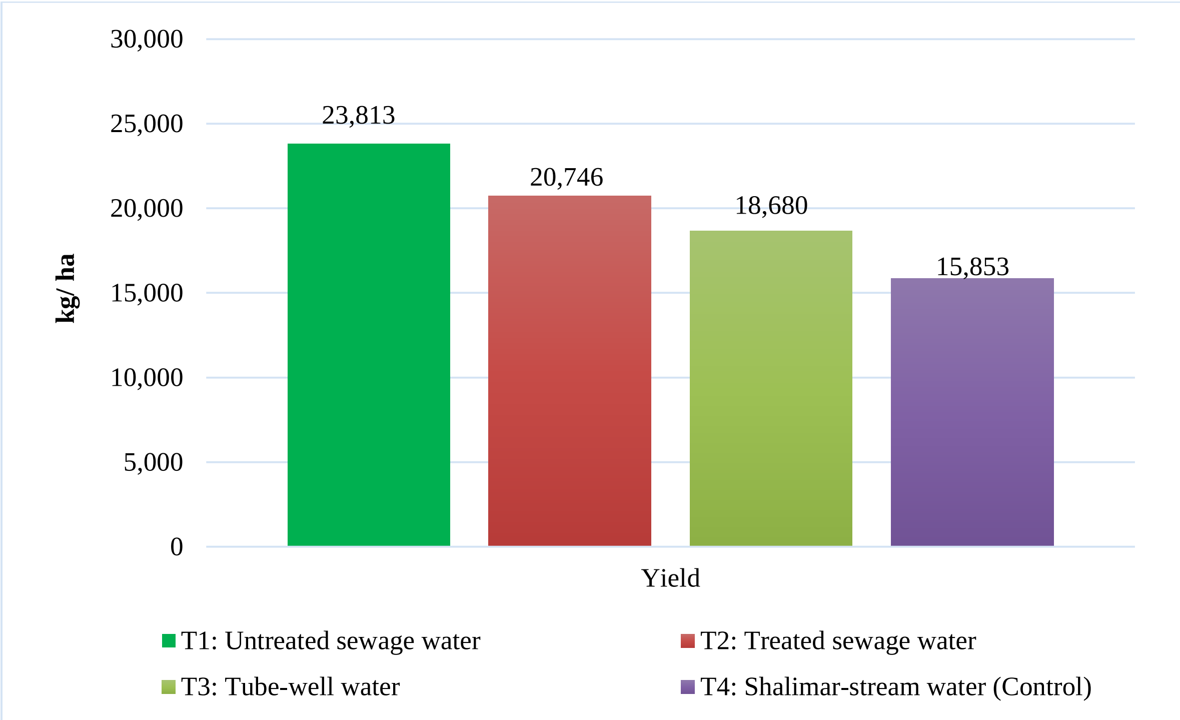


Fig. 3: Effect of different water resources on yield parameter of kale

**Chlorophyll contents (mg/g)**

It is inferred from the results presented in Table 3 and Fig. 4 that application of untreated sewage water, treated sewage water and tube well water resulted in increase in the content of chlorophyll a, chlorophyll b and total chlorophyll in crop as compared to Shalimar stream water. ($T_1$: 2.31, 0.80 and 3.11mg/g; $T_2$: 2.17, 0.69 and 2.87mg/g; $T_3$: 1.79; 0.63 and 2.43 mg/g and $T_4$: 1.39, 0.54 and 1.93 mg/g respectively). The favourable effect of untreated sewage water on the synthesis and accumulation of chlorophyll may be attributed to the availability of nitrogen supplied by sewage, which is essential in the structure of porphyrin, found in such metabolically important compounds as chlorophyll. Similar findings have been reported by Abdel Latef and Sallam (2015) and Hassena et al. (2018)

Table 3: Effect of different water resources on chlorophyll content (mg/g) in kale

| Treatments / Parameters | Chlorophyll "a" | Chlorophyll "b" | Total Chlorophyll |
|---|---|---|---|
| $T_1$: Untreated sewage water | 2.31 | 0.80 | 3.11 |
| $T_2$: Treated sewage water | 2.17 | 0.69 | 2.87 |
| $T_3$: Tube-well | 1.79 | 0.63 | 2.43 |
| $T_4$: Shalimar stream (Control) | 1.39 | 0.54 | 1.93 |
| C.D. ($p \leq 0.05$) | 0.026 | 0.024 | 0.039 |

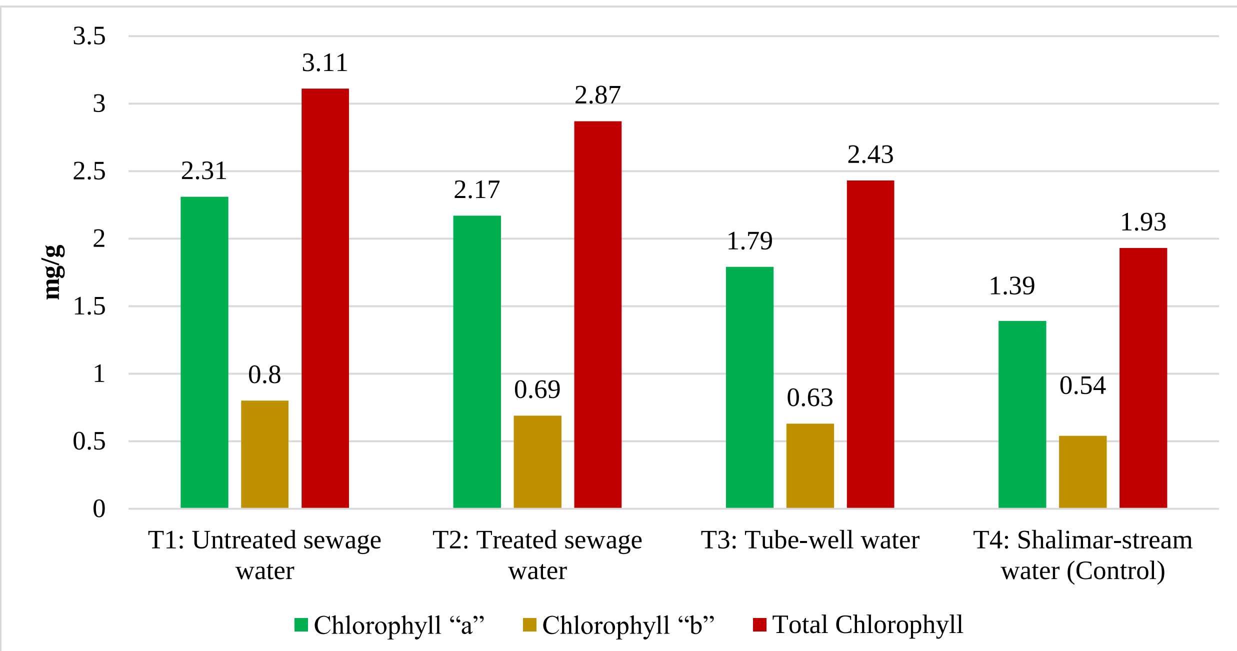


Fig. 4: Effect of different water resources on chlorophyll content (mg/g) in kale

## Conclusion

From the present study, it can be concluded that the crop has responded well to sewage irrigation treatment in terms of yield attributes and biochemical adjustments. It can thus be suggested that both untreated/treated waste water can be used to irrigate kale or other vegetables with a continuous monitoring of the effluent quality to avoid contamination.

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**Conflict of Interest:**

Authors declare no conflict of interest

**References**

Abdel Latef, A. A. and Sallam, M. M. 2015. Changes in Growth and Some Biochemical Parameters of Maize Plants Irrigated with Sewage Water. *Austin Journal of Plant Biology* **1**(1): 1004.

Arora, M., Kiran, B., Rani, S., Rani, A., Kaur, B. and Mittal, N. 2008. Heavy metal accumulation in vegetables irrigated with water from different sources. *Food Chemistry* **111**(4): 811-815.

Biscay, R. C. M. and Miranda, G. M. 1996. Use of sewage sludge in maize production. *Technical Journal of Sanepar* **5**(05): 86-89.

Courault, D., Albert, I., Perelle, S., Fraisse, A., Renault, P., Salemkour, A. and Amato, P. 2017. Assessment and risk modeling of airborne enteric viruses emitted from wastewater reused for irrigation. *Science of the Total Environment* **592**: 512-526.

Dar, Z. A. Bhat, J. I. A. Lone, F. A. Ali, T. Mir, S. A. Khan S. H. and Singh. P. 2019. Impact of sewage sludge and Dal weed compost on yield and quality attributes of kale (*Brassica oleracea* var. *acephala* L.) in Kashmir. *Journal of Pharmacognosy and Phytochemistry* 8(1): 853-856.

Hassena, A. B., Zouari, M., Trabelsi, L., Khabou, W. and Zouari, N. 2018. Physiological improvements of young olive tree (*Olea europaea* L. cv. Chetoui) under short term irrigation with treated wastewater. *Agricultural Water Management* **207**: 53-58.

Hiscox, J. T. and Israelstam, G. F. 1979. A method for the extraction of chlorophyll from leaf tissue without maceration. *Canadian Journal of Botany* **57**(12): 1332-1334.

Jorge, J. A., Camargo, O. A. and Valadares, J. M. 1991. Physical conditions of a Dark Red Latosol four years after application of sewage sludge and limestone. *Brazilian Journal of Soil Science* **15**(3): 237-240.

Melo, W. J., Marques, M. O., Santiago, G., Chelli, R. A. and Leite, S. A. S. 1994. Effect of increasing doses of sewage sludge on fraction of organic matter and CTC of a latosol grown with sugar cane. *Brazilian Journal of Soil Science* **18**(3): 449-455.

Raeisi-Vanani, H., Soltani-Toudeshki, A. R., Shayannejad, M., Ostad-Ali-Askari, K., Ramesh, A., Singh, V. P. and Eslamian, S. 2017. Wastewater and magnetized wastewater effects on soil erosion in furrow irrigation. *International Journal of Research Studies in Agricultural Sciences (IJRSAS)* **3**(8): 1-14.

Sadiq, B, M., Sharif, K., Ehsan-Bajwa, B. and Aziz, A. 2005. Hazardous effects of sewage water on the environment: Focus on heavy metals and chemical composition of soil and vegetables. *Management of Environmental Quality: An International Journal* **16**(4): 338-346.

Sahay, S., Inam, A. and Iqbal, S. 2013. Effect of wastewater irrigation on soil, metal tolerance and its remediation by four oil yielding Brassica cultivars. *International Journal of Environmental Sciences* **4**(2): 158.

Shilpi, S., Seshadri, B., Sarkar, B., Bolan, N., Lamb, D. and Naidu, R. 2018. Comparative values of various wastewater streams as a soil nutrient source. *Chemosphere* **192**: 272-281.

Uttara, T., Bahadur, A. N. and Prerna, S. 2018. The impact of sewage water on growth promotion and yield in wheat crop plants in Bilaspur city (CG) India. *International Journal of Life Sciences* **6**(2): 494-499.