International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(2): 81-85

Received: 14-01-2017
Accepted: 15-02-2017

SD Zodge
Department of Soil Science and Agril. Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli- 415 712, Dist. Ratnagiri, Maharashtra, India

UY Puranik
Department of Soil Science and Agril. Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli- 415 712, Dist. Ratnagiri, Maharashtra, India

VD Kapse
Department of Soil Science and Agril. Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli- 415 712, Dist. Ratnagiri, Maharashtra, India

SB Dodake
Department of Soil Science and Agril. Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli- 415 712, Dist. Ratnagiri, Maharashtra, India

Correspondence
SD Zodge
Department of Soil Science and Agril. Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli- 415 712, Dist. Ratnagiri, Maharashtra, India

Effect of factory effluent and inorganic fertilizers on growth, yield and ascorbic acid content at various cuttings of spinach (*Beta Vulgaris Var. Bengalensis*) in lateritic soil of Konkan (M.S.)

SD Zodge, UY Puranik, VD Kapse and SB Dodake

Abstract
A field experiment on effect of factory effluent and inorganic fertilizers on growth, yield and nutrient uptake by spinach beet (Beta vulgaris var. bengalensis) in lateritic soil of Konkan was conducted with Randomized Block Design comprising nine treatments replicated thrice at Central Experiment Station, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri during Rabi 2013-14. The effect of application of effluent before sowing and after first harvest (cutting) with and without NPK fertilizers @ 100, 50 and 25 per cent of recommended dose on growth, yield and ascorbic acid content by plant was studied. From study it was found that the application of effluent before sowing with inorganic fertilizers or application of effluent before sowing and after first cutting with inorganic fertilizers significantly increased the growth parameters viz., plant height, number of leaves plant^{-1}, yield and ascorbic acid content in plant.

Keywords: Spinach, lateritic soil, Konkan

Introduction

Spinach beet is also known as Indian spinach in English and Palak in Hindi. It is most common leafy vegetable in India. Palak belongs to same species in which beet root, sugar beet, swiss chard are included. Since palak was grown earlier in Bengal, it is known as (Beta vulgarisvar. bengalensis). Palak is one of the most common leafy vegetable crop of tropical and sub-tropical region and is grown widely in India. The popular palak growing States are Uttar Pradesh, West Bengal, Punjab, Haryana, Delhi, Madhya Pradesh, Gujarat and Maharashtra. However, palak is not very popular in South India. It is rich and cheap source of vitamin 'A' (5862 iµ) as compared to carrot. It contains high quality of ascorbic acid (70 mg) and iron (16.2 mg) per 100 g. It is good source of folacian. The major carotenoid is lutein (1303 µg) and β- carotene (1095 µg) per 100 g edible portion. Vitamin 'C' and folate is present in palak is destroyed by even simple processing such as cutting and washing.

Under the present trend of exploitive agriculture in India, inherent soil fertility can no longer be maintained on the sustainable basis. It is said that nutrient supplying capacity of soil declines steadily under continuous and intensive cropping system. The use of optimum levels of N, P and K failed to maintain yield levels probably due to increasing secondary and micronutrient deficiencies and also unfavourable alterations in the physical and chemical properties of soil. Apart from the fertility and productivity issues, use of chemical fertilizers is also becoming more and more difficult for the farmers due to their high costs and scarcity during peak season. Though, the lateritic soils are the best suited for spinach cultivation, extremely suffers by low yield especially due to acidic soil, deficiency of major nutrients (N and P) and lack of affordability of farm inputs. The use of effluent either in liquid or solid form in agriculture has been practiced in India, since the inception of the industry. In certain areas, the scarcity of water has forced the farmers to use the effluent as a substitute for irrigation water over the years. The indiscriminate disposal in the open area and near natural water bodies causes high water table and contaminate surface and ground waters making them unsuitable for use. Since the conventional methods of waste treatment are uneconomical and especially the difficulty in handling and transporting of large quantities, alternative methods like application of effluents to agricultural land is receiving increasing attention. The increasing cost of fertilizers and most essential nutrients also demand the attention as spent wash contains high amount of nutrients like nitrogen, phosphorus, potassium, calcium and sulphur. In addition, it contains sufficient amount of micronutrients like iron, zinc, copper and manganese (Suganaya and Rajanna, 2009) [16]. This is an important problem of the industries and challenge for the scientists how to use this resource as a source of nutrients and irrigation in crop production.

The effluents have been recommended for amendment of acidic soils, but their long-term effect happens to be injurious for soil fertility and this aspect has been not studied in detail. In certain cases, the diluted effluents enhanced the growth of the plants, which might be due to the presence of phenolic compounds rendering the beneficial effect on the plant growth. As such, not very much work has been carried out under Konkan condition as the effect of factory effluent on any leafy vegetable crop. It was, therefore, necessary to undertake experiment to study the effect of factory effluent as a source of irrigation as well as source of nutrients. Hence, the present investigation entitled, "Effect of factory effluent and inorganic fertilizers on growth, yield and ascorbic acid content by spinach in lateritic soil of Konkan''

Materials and Methods

The present field experiment was conducted at Research Farm of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during Rabi season 2014.The analytical work was carried out in the research laboratory of the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dapoli. The selection of site was done on the basis of suitability of land for the cultivation of Spinach. The 'All Green' variety of spinach was released by IARI New Delhi in 1980 had been selected as test crop for this study. Effluent (composite sample of digester over flow) from the Saf Yeast Company Private Limited, Gane-Khadpoli, Chiplun District-Ratnagiri was collected and applied to the crop. The effluent was analyzed for different chemical parameters using standard methods. Based on the irrigation requirement of the crop per plot quantity of effluent was calculated and applied directly to the plot before sowing and after first cutting of spinach as per thetreatments. The field experiment was laid out in randomized block design comprising of nine treatments combinations with three replications and the details are as follows: T_1 -Recommended dose of fertilizers (100: 50: 50 N: P2O5 : K2O kg ha-1), T_2 - Application ofEffluentbefore sowing, T_3 - T_2 + 100% RDF, T_4 - T_2 + 50% RDF, T_5 - T_2 + 25% RDF, T_6 - Application ofEffluentbefore sowing and after 1st cutting, T_7 - T_6 + 100% RDF, T_8 - T_6 + 50% RDF, T_9 - T_6 + 25% RDF.

After preparation of the layout, treatment wise effluent was applied to the experimental plots. The quantity of the effluent per plot was calculated by considering the irrigation water requirement of the crop. The 600 liters of irrigation effluent was applied to each plot as per the treatment before sowing. After 5 days, the soil of the treated plots was thoroughly mixed by cultivator to facilitate aeration and oxidation. Again after first cutting ofcrop nearly about 35 days 2nd application of effluent 600 liter per plot was done as per the treatments. As per the recommendation and treatments plant nutrients like N, P and K were applied through different fertilizers viz., urea, single super phosphate and muriate of potash. After fertilizer application, the line sowing was done by keeping the distance 20 cm between two lines. The various cultural operations were undertaken when required. The dark green and tender leaves were harvested and treatment wise yield data were recorded. In order to study the effect of various treatments on the growth parameters, yield contributing characters and yield observations were recorded from time to time. For recording biometric observations five plants were randomly selected in each plot. The selected plants were marked and labeled with zinc labels with proper notations. The plant height was recorded from randomly selected plants and then the average was worked out. Height of plant was measured in centimeter from the ground level to the tip of leaves. The number of functional leaves i.e. the total number of leaves on the plant was counted. The leaves of spinach were cut from the plot of each treatment and the recorded yield of leaves was converted into hectare basis. The ascorbic acid content in green leaves of spinach was estimated by 2, 6-dichlorophenol indophenol dye method (Ranganna, 1985) [15]. The data obtained were subjected to statistical analysis by using the standard procedure pertinent to Randomized Block Design (RBD) given by Panse and Sukhatme (1995) [10].

Results and Discussion

The effect of different treatments on growth, yield and ascorbic acid content by crop was studied. The observations and analytical values obtained during course of study were analyzed statistically, described and contemplated to discuss the variations observed with an attempt to establish the 'effect and cause' relationship in the light of available evidences and literature.

Effects on growth parameters at various cuttings of spinach

The data pertaining growth parameters viz., plant height and number of leaves of average five plants as influenced by different treatments are presented in Table 1.

Plant height (cm)

The height of plant significantly affected due to application of effluent before sowing and after first cutting with inorganic fertilizers at various cuttings of spinach (Table 1).The height of plant ranged from 22.37 cm to 35.91 cm, 20.37 cm to 33.10 cm and 23.67 to 30.13 cm at 1^{st} cutting, 2^{nd} cutting and 3^{rd} cutting, respectively. Further, the plant height was significantly decreased from 1st to 3rd cutting which might be due to the fact that pruning encourages the development of side shoots andresulted in increasing side shoots and decreased in plant height Bharad *et al*. (2013) [2].

At the time of first cutting of spinach, the treatment (T_7) receiving application of effluent before sowing and after first cutting + 100 per cent RDF, recorded the highest value (35.91 cm) and the significantly lowest value noted by treatment T_1 (22.37 cm) i.e. application of RDF. Further, it was found that application of effluent + 25% RDF (T5) at 2nd cutting showed highest plant height (33.10 cm), while the lowest plant height (20.37 cm) was recorded at T1. At the time of 2nd cutting plant showed minimum height as compare to 1st cutting. This may be due to application of pure effluent indicating adverse effect on plant height from treatment T6 to T9. At 3rd cutting T3 recorded the highest plant height (30.13 cm) where one time application of effluent before sowing + 100% RDF were applied and lowest plant height (23.67 cm) observed at treatment T2.

The plant height was significantly decreased from 1st to 3rd cutting which might be due to the fact that pruning encourages the development of side shoots andresulted in increasing side shoots and decreased in plant height Bharad *et al*. (2013) [2]. Increase in the height of plant with the application of effluent in lateritic soils of Konkan was also reported by Patil (2012) [6] in rice and Parte (2013) [11] in okra. Increase in the plant height with the application of effluent in lateritic soils of Konkan was also obtained in case of brinjal and chilli (Anonymous 2014) [1]. Chandraju and Basavaraju (2007) [3] reported that the application of diluted spent wash increased the height and growth of vegetables.

Table 1: Effect of factory effluent and inorganic fertilizers on plant height and no. of leaves at various cuttings of spinach.

Tr. No.	Treatments	**Plant height** (cm)			**No. of leaves** (plant^{-1})		
		1st cutting	**2nd cutting**	**3rd cutting**	**1st cutting**	**2st cutting**	**3rd cutting**
T_1	RDF (100:50:50 kg ha^{-1})	22.37	20.37	--	7.53	8.60	--
T_2	Application of effluent before sowing	31.11	30.97	23.67	8.73	13.07	14.47
T_3	T_2 + 100% RDF	34.41	29.87	30.13	9.27	15.00	16.80
T_4	T_2 + 50% RDF	31.15	27.70	25.31	9.00	15.13	16.80
T_5	T_2 + 25% RDF	35.10	33.10	24.31	7.80	13.60	15.00
T_6	Application of effluent before sowing and after 1st cutting	32.35	27.82	27.37	7.73	11.10	14.73
T_7	T_6 + 100% RDF	35.91	26.85	26.51	9.93	15.20	16.93
T_8	T_6 + 50% RDF	34.85	25.63	25.50	8.40	14.00	14.93
T_9	T_6 + 25% RDF	30.61	24.93	24.86	7.67	15.00	15.93
	S.E.±	1.25	1.57	1.23	0.49	1.06	0.64
	C.D. (P=0.05)	3.76	4.69	3.72	1.46	3.16	1.92

Number of leaves (plant^{-1})

Number of leaves of spinach was affected significantly due to application of effluent before sowing and after first cutting with inorganic fertilizers, which varied from 7.53 to 9.93 at 1st cutting, from 8.60 to 15.20 at 2nd cutting and 14.47 to 16.93 at 3rd cutting (Table 8). It is seen from the data that the number of leaves per plant was increased with increase in cutting frequencies. The increase in number of leaves with cuttings may be due to the fact that, pruning encourages development of side shoots which resulted in increase in number of leaves per plant after 1st and 2nd cutting (Bharad *et al*. 2013) [2]. The above results are also in conformity with that of Kastureet *al*. (2000) [6] in Indian spinach, where number of leaves per plant increased with increasing cutting frequencies.

The data indicated that in Table 8, the highest number of leaves were recorded in treatment T_7 where application of effluent before sowing and after first cutting + 100 % RDF was applied, which was (9.93) at 1st cutting, at 2nd cutting (15.20) and at 3rd cutting (16.93).The increase in number of leaves per plant might be due to fact that urea impart vigorous vegetative growth plant and pruning encouraged optimum number of leaves which resulted in increase in leaves of plant (Bharad *et al.* 2013) [2]. In this connection, Lal *et al.* (1979) [7] and Bharad *et al.* (2013) [2] reported the increased number of leaves of *Beta vulgaris* with increase in cutting frequencies.

Effect on yield of spinach

Yield of spinach at various cuttings (t ha^{-1})

At 1st cutting the highest yield was found in the treatment (T_7) where application of effluent before sowing and after first cutting + 100 % RDF was applied, at 2nd cutting treatment T_2 (application of effluent before sowing) reported significantly higher yield (23.85 t ha^{-1}) and At 3rd cutting treatment T_9 (application of effluent before sowing and after 1st cutting + 25 % RDF) reported significantly higher yield.

Total Yield of spinach (t ha^{-1})

The significant difference in total yield of spinach was found due to application of effluent before sowing and after first cutting. The yield of spinach was varied from 8.35 to 68.90 t ha^{-1} (Table 2).

Table 2: Effect of factory effluent and inorganic fertilizers onyield at various cuttings of spinach

Tr. No.	Treatments	**Yield** (t ha^{-1})			
		1st cutting	**2nd cutting**	**3rd cutting**	**Total**
T_1	RDF (100:50:50 kg ha^{-1})	6.50	1.84	--	8.35
T_2	Application of effluent before sowing	26.67	23.85	4.25	54.77
T_3	T_2 + 100% RDF	32.59	23.65	12.65	68.90
T_4	T_2 + 50% RDF	30.18	20.11	7.16	57.45
T_5	T_2 + 25% RDF	30.84	20.90	9.34	61.09
T_6	Application of effluent before sowing and after 1st cutting	29.42	7.19	12.06	48.68
T_7	T_6 + 100% RDF	33.57	10.08	11.28	54.93
T_8	T_6 + 50% RDF	30.50	6.58	9.71	46.79
T_9	T_6 + 25% RDF	25.20	3.51	13.35	42.05
	S.E.±	2.10	2.23	1.33	3.00
	C.D. (P=0.05)	6.29	7.00	4.03	9.00

Among the various treatments, (application of effluent before sowing + 100 % RDF) treatment T_3 registered the highest total yield (68.90 ton ha^{-1}), which was at par withtreatment T_4 (61.10 t ha^{-1}), where application of effluent before sowing + 50 % RDF was applied, but significantly superior over rest of the treatments. Increase in the yield with the application of effluent in lateritic soils of Konkan was also reported by Patil (2012) [12] in rice and Parte (2013) [11] in okra. The factory effluent contains high level of plant nutrients which are made available to the plant, thus resulting in better growth and development of the crop (Suganya and Rajannan, 2009) [16]. Application of nitrogen generally improved the growth of spinach; this might be explained on the basis that N is an essential element for plant growth (El- Gizaway *et al*. 1992) [5].

The close scrutiny of data indicated that application of effluent before sowing (treatment T_2, T_3, T_4 and T_5) recorded the higher yield as compared with the application of effluent before sowing and after first cutting (treatment T_6, T_7, T_8 and T_9). Rajukkannu (2001) [13] reported that undiluted effluent if applied in fallow lands during summer, facilitating oxidation of organic matter and reduction of BOD which was increased crop yield. Padmanabha *et al*. (2013) [9] noticed that green leaf yield increases linearly as organic and inorganic fertilizers levels increased.

Dry matter production (q ha^{-1})

Dry matter production at various cuttings

The data on dry matter production (Table. 3) revealed that the dry matter production was varied from 4.60 to 24.28 q ha^{-1} at 1st cutting, 1.20 to 17.14 q ha^{-1} at 2nd cutting and 3.06 to 10.14 q ha^{-1} at 3rd cutting. At 1st cutting the highest dry matter production was found in treatment T_8 (application of effluent before sowing and after first cutting + 50 % RDF), at 2nd cutting in treatment T_2 (application of effluent before sowing) reported that the highest dry matter production and At 3rd cutting the treatment T_9 (application of effluent before sowing and after first cutting + 25 % RDF) showed the highest dry matter production.

Table 3: Effect of factory effluent and inorganic fertilizers on dry matter production at various cuttings of spinach.

Tr. No.	Treatments	Dry matter (q ha^{-1})			
		1st cutting	2nd cutting	3rd cutting	Total
T_1	RDF (100:50:50 kg ha^{-1})	4.60	1.20	--	5.80
T_2	Application of effluent before sowing	19.27	17.14	3.06	39.48
T_3	T_2 + 100% RDF	23.16	17.00	9.91	50.06
T_4	T_2 + 50% RDF	22.02	14.29	5.15	41.46
T_5	T_2 + 25% RDF	20.97	13.77	6.23	40.97
T_6	Application of effluent before sowing and after 1st cutting	21.19	5.40	8.57	35.16
T_7	T_6 + 100% RDF	24.17	7.02	8.14	39.32
T_8	T_6 + 50% RDF	24.28	4.70	6.50	35.48
T_9	T_6 + 25% RDF	19.20	2.38	10.14	31.72
	S.E.±	1.52	1.64	1.04	2.47
	C.D. (P=0.05)	4.56	4.91	3.15	7.39

The data indicated that the dry matter production was decreased continuously from 1st to 3rd cutting, but it was increased in case of treatment T_6 to T_9 at 3rd cutting, it may be due to 2nd time application of effluent which affected the growth of spinach in treatment T_6 to T_9 at 3rd cutting. Ramana *et al*. (2002) [14] in maize and Devarajan and Oblisami (1995b) [4] in sugarcane reported that increasing dry matter due to application sewage-effluent up to dilution and further reduction in dilution decreased the straw yield.

Total dry matter production (q ha^{-1})

The data on total dry matter (Table. 3) revealed that it was significantly affected by application of effluent before sowing with inorganic fertilizers and application of effluent before sowing and after first cutting of spinach. The total dry matter varied from 5.80 to 50.06 (q ha^{-1}). The highest dry matter of spinach (50.06 q ha^{-1}) was observed in the treatment T_3 (application of effluent before sowing + 100 % RDF), which was significantly superior over all other treatments. The treatment T_1 i.e. application of (100 % RDF) recorded the lowest dry matter (5.80 q h^{-1}). Increase in dry matter was also reported by Parte (2013) [11] in okra and Patil (2012) [12] in rice with application of different concentration of effluent with inorganic fertilizers in lateritic soils of Konkan. The factory effluent contains high level of plant nutrients which are made available to the plant, thus resulting in better growth and development of the crop (Suganya and Rajannan, 2009) [16]. Nandy *et al*. (2002) [8] found that increasing dry matter due to application sewage-effluent up to the dilution and further reduction in dilution decreased the straw yield in rice.

Effect on ascorbic acid content in spinach (mg/100 g)

The ascorbic acid content in spinach was affected by various treatments is given in Table. 4 and time intervals indicated that its content varied from 40.94 to 57.93 mg/100 g at 1st cutting, 37.98 to 52.40 mg/100 g at 2nd cutting and 39.13 to 48.92 mg/100 g at 3rd cutting.The data showed that the highest ascorbic acid content was found in treatment T_7 (application of effluent before sowing and after 1st cutting + 100 % RDF) in all cuttings i.e. from 1st to 3rd cutting (57.93 mg/100 g at 1st cutting, 52.40 mg/100 g at 2nd cutting and 48.92 mg/100 g at 3rd cutting)

Table 4: Effect of factory effluent and inorganic fertilizers on ascorbic acid content in plant at various cuttings of spinach

Tr. No.	Treatments	Vitamin 'C' (mg/100g)		
		1st cutting	2nd cutting	3rd cutting
T_1	RDF (100:50:50 kg ha^{-1})	40.94	37.98	--
T_2	Application of effluent before sowing	47.81	41.00	39.13
T_3	T_2 + 100% RDF	54.74	48.20	47.74
T_4	T_2 + 50% RDF	50.30	44.24	43.51
T_5	T_2 + 25% RDF	49.71	42.80	41.36
T_6	Application of effluent before sowing and after 1st cutting	44.40	43.11	42.00
T_7	T_6 + 100% RDF	57.93	52.40	48.92
T_8	T_6 + 50% RDF	54.40	51.97	47.92
T_9	T_6 + 25% RDF	52.05	47.28	45.60
	S.E.±	2.35	1.60	1.60
	C.D. (P=0.05)	7.05	4.78	4.86

The data showed that the ascorbic acid content was decreased continuously from 1st to 3rd cutting where application of effluent before sowing and after 1st cutting with inorganic fertilizers were applied, Similar decreasing trend was observed by Bharad *et al*. (2013) [2] and he found that the ascorbic acid content was 70.24, 68.20 and 64.98 mg/100 g at 1st, 2nd and 3rd cutting, respectively with application of RDF. Verma *et al.* (1961) [17] observed that, in spinach when nitrogen level increased from 80 to 200 kg ha^{-1} ascorbic acid content was also increased as compared to lower nitrogen level.

Conclusion
Based on the yield response application of effluent before sowing with or without inorganic fertilizers and application of effluent before sowing and after 1st cutting with inorganic fertilizers was found to be suitable for spinach in lateritic soils of Konkan.

References

1. Anonymous. Suitability of factory waste water for rice and vegetables. A report submitted to Dr. B.S.K.K.V., Dapoli, 2014.
2. Bharad SG, Korde SD, Sapute P, Baviskar MN. Effect of organic manures and number of cutings on growth, yield and quality of Indian spinach. The Asian Journal of Horticulture2013; 8(1):60-64.
3. Chandraju S, Basavaraju HC. Impact of distillery spentwash on seed germination and growth of leaves vegetables: An investigation. Sugar journal (SISSTA) 2007; 38:20-50.
4. Devrajan L, Oblisami G. Effect of distillery effluent on soil fertility status yield and quality of Rice. Madras. Agric. J 1995b; 82(12):664-665.
5. El-Gizawy AM, Saraf A, El-Oksh, El-Hobar M. Effect of sowing date andnumber of nitrogen application on spinach plants. Egypt. J Hort 1992; 19(2):201-208.
6. Kasture VM, Chauhan PS, Patil VN, Shivankar RS,Wankhade KN. Effect of cutting on the vegetative growth of Indian spinach. J. Article. 2000; 1(3):416-417.
7. Lal S, Pandy UC, Pandit ML, Singh K. Effect of nitrogen and cutting on the seed production of Beta vulgaris. Seed Res., 1979; 7(2):136-140.
8. Nandy T, Shastri S, Kaul SN. Wastewater management in a cane molasses distillery involving bio resource recovery. Journal of Environmental Management. 2002; (65):25-38.
9. Padmanabha K, Nagaraja M, Kumar GN, Veera Hanumanthappa DC, Krishnappa KS. Performance and correlation studies on nutritional uptake and nutritional content by various organic and inorganic fertilizers on spinach. Vegetable Science.2013; 40(1):114-116.
10. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers ICAR, New Delhi, 1961.
11. Parte PR. Effect of factory effluent, organic manures and inorganic fertilizers on growth, yield and nutrient uptake by okra in lateritic soil of Konkan. M.Sc. (Ag.) Thesis submitted to Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, 2013.
12. Patil PV. Effect of factory effluent (Saf yeast) on growth, yield, nutrient uptake by rice and changes in soil properties. M.Sc. (Ag.) Thesis submitted to Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, 2012.
13. Rajukkanu K. Proc. Natnl. Sym. Use of poor Quality Water and Sugar Industrial Effluents in Agriculture. Feb. 5th, 2001.AC and RI, Trichy.2001, 39-49.
14. Ramana S, Biswas AK, Singh AB. Effect of distillery effluent on some physiological aspects in maize.Bioresearch Technology.2002; 84:295-297.
15. Ranganna S. Manual of analysis of fruit and vegetables products. Tata Mc Graw Hill publishing Co. Ltd., New Delhi 1985, 9-82.
16. Suganaya K, Rajanna G. Effect of one time post-sown and pre-sown application of distillery spentwash on the growth and yield of maize crop. Botany research International.2009; 2(4):288-294.
17. Verma AN, Shrivasteva DC, Sharma K. Effect of nitrogen supply on growth, yield, ascorbic and oxalic acid content in spinach. Plant science.1961; 1:189-191