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RESEARCH ARTICLE

# Effect of Sewage Water Application and Nutrients on the Yield and Nutrient Uptake of Fodder Cowpea

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## ABSTRACT

A pot culture experiment was conducted at the Department of Agronomy, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai, to study the effect of irrigation water and nutrients on the yield and nutrient uptake of fodder cowpea. The experiment consisted of two factors with irrigation water and nutrients with three and four treatments respectively. The results of the experiment indicated that the application of sewage water along with recommended dose of farm yard manure and inorganic nutrients enhanced the growth attributes and yield of fodder cowpea. The leaf stem ratio was found higher with the application of sewage water and the application of farm yard manure and inorganic nutrients. The increase in yield of cowpea with higher nutrient content resulted in increased nitrogen, phosphorous and potassium uptake by fodder cowpea. The post harvest samples have shown that application of sewage water and nutrients to the soil had positively resulted in the uptake of nutrients by fodder cowpea. Application of sewage water along with the recommended dose of nutrients resulted in 22.3 percentage of yield compared to application of irrigation water and without nutrient application.

**Keywords:** *Sewage Water, Nutrients, Yield, Nutrient uptake, Fodder cowpea*

## INTRODUCTION

India, posses 535.8 million livestock (Livestock Census, DAHD&F). India ranks first in milk production, meat and egg. However, the productivity of cattle in India is 1777 kg per animal per year which low compared to the world average of 2699 kg per animal per year during 2019 (FAO Statistics, 2021). The reasons attributed to low productivity is malnutrition or under nutrition along with genetic potential of the animals. To enhance the productivity of the animals, it is essential to supplement the livestock with balanced feed using green fodders, dry fodders and concentrates. National Institute of Animal Nutrition and Physiology (NIANP) estimated that the deficit in the requirement and the availability of dry fodder, green fodder and concentrates during 2015 was to the extent of 21 per cent, 26 per cent, and 34 per cent, respectively. This is likely to increase to 23 per cent, 40 per cent, and 38 per cent, respectively, by 2025. To meet the daily requirement of animals, the animals are usually provided with low quality crop residues obtained from agricultural activities. The main reason behind the deficit of green fodders is the lesser allocation of land for cultivation of fodder crops and the utilisation of water as these can be diverted for cultivation of food and high value crops that provides direct income to the farmers.

To overcome the increasing demand for domestic water of the world has resulted in the utilisation of sewage water for agriculture. The sewage water has been used as potential source for raising fodder crops. It is a rich source of organic and inorganic nutrients for plant growth and if properly used for irrigation, it enhances the nutrient availability in the soil. Little is known about the effect of sewage water on the yield of fodder crops (Khan *et al*., 2008)

Fodder cowpea is an annual crop with shorter duration. With assured water supply, the fodder cowpea can be grown in the cropping system. There is a little-known fact on the response of fodder cowpea to application of sewage water.

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Hence, the present study was conducted to assess the yield of fodder crop and its nutrient availability with respect sewage water and nutrient application.

## MATERIAL AND METHODS

Pot culture experiments were conducted during 2019-2020 at the Department of Agronomy, Madras Veterinary college, Tamil Nadu Veterinary and Animal Sciences University. The institute is located in the North Eastern agro-climatic zone of Tamil Nadu at 13.04$^0$ N latitude, 80.17$^0$ E longitude and at an altitude of 6.7 m above MSL. The mean annual rainfall of the zone varies from 800-1400 mm. The mean maximum and minimum temperatures were 29 and 41.9°C during 2019 in summer and *kharif* seasons. The mean annual rainfall recorded was 999 mm during 2019 with an average humidity of 70%. The soil used for pot culture experiment was red soil and the chemical analysis of soil indicated that the soil available nitrogen was 165.8 kg ha$^{-1}$, phosphorus was 17.06 kg ha$^{-1}$, potassium was 238.7 kg ha$^{-1}$ and the organic carbon content was 0.25%. The soil was red soil with moderate alkalinity (7.64) and an electrical conductivity of 0.38 dSm$^{-1}$.

The pot culture was laid out in a factorial completely randomized design with three replications. Treatment comprises three levels of irrigation sources viz., $T_1$: Irrigation water, $T_2$: Sewage water and $T_3$: Irrigation water + Sewage water alternatively under factor A and four nutrient treatments viz., $N_1$: Control, $N_2$: Farm Yard manure alone, $N_3$: Farm Yard manure + NPK and $N_4$: NPK alone under factor B. Sewage water was collected near the Dairy Science Block and irrigation water from the bore well of the Madras Veterinary College and added the required quantity of water throughout the experimental period. For the organic source of nutrients, farm yard manure was applied @ 12.5 tonnes per hectare and inorganic nutrients in the form of urea, single super phosphate and muriate of potash @ 25:40:20 kg NPK/ha. The quantity of nutrients applied were 0.136, 0.625, 0.084 and 31.3 g/pot of urea, single super phosphate and muriate of potash and farm yard manure respectively. The quantity of nutrients were calculated as per the quantity of soil used in the pots. Seeds of fodder cowpea variety Co 9 were sown in the pots by dibbling method. Nutrients were applied basally, all the agronomic management practices were carried out as per the crop production guide (TNAU). Growth and yield parameters were recorded by sampling the grown plants. Total nitrogen uptake was analyzed by the standard procedure of micro Kjeldahl method (Humphries, 1956). Similarly, phosphorus and potassium uptake were analyzed by triple acid digestion method (Jackson, 1973) and expressed in kgha$^{-1}$. The statistical analysis were done using the statistical method of factorial randomized block design. Wherever the results were significant, the critical difference at 5 % level of significance was worked out as given by Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

### *Growth attributes*

Cowpea is an annual plant and the plant height is influenced by application of irrigation water and nutrients. Application of sewage water throughout the crop growth has resulted in higher plant height of 48.85 cm followed by irrigation water application and sewage water alternatively (Fig. 1). With respect to nutrients, combination of organic and inorganic nutrients with the recommended doses has resulted in higher plant height of 53.13 cm. Similarly, the number of leaves per plant and number of branches per plant were found higher with the application of sewage water and combination of organic and inorganic nutrients with the recommended doses. However, plants without application of nutrients have resulted in lesser plant height, number of leaves per plant and number of branches per plant. This might be due to the fact that the nutrient available in the sewage water and the application of nutrients had synergistic effect in the availability of nutrients to the plants and thereby enhancing the growth parameters of the plants. This is in conformity with the findings of Kumar and Reddy (2007) and Soyalsan and Karaguzel (2007).

### *Yield*

The whole plant of fodder cowpea is used for feeding animals as well as for preservation such as silage and hay making. Application of sewage water and combination of organic and inorganic nutrients had significant influence on the plant weight per plant of cowpea (Fig. 2). The application of sewage water had resulted in higher plant weight per plant (118.15 g plant$^{-1}$), plant biomass per hectare (26.26 t ha$^{-1}$) and leaf stem ratio (0.44). Combination of organic and inorganic nutrients had significant influence on the plant weight per plant, plant biomass per hectare and leaf stem ratio of cowpea compared to the application of organic nutrients alone or inorganic nutrients alone.

The interaction between application of water and nutrients were found significant. This might be due to better uptake and utilization of nutrients and the resultant better growth that led to higher biomass production. Further, the organic manure could have made the nutrients available. This is in line with the findings Heba *et al.* (2019).

### *Nutrient uptake (kg ha$^{-1}$)*

Significantly higher nitrogen (123.66 kg ha$^{-1}$), phosphorus (13.370 kg ha$^{-1}$) and potassium (102.34 kg ha$^{-1}$) uptake were registered with application of sewage water (Fig.3). The application of organic and inorganic nutrients resulted in higher nutrient uptake by the plants. The lower nitrogen, phosphorus and potassium uptake were registered with control (without nutrients) and irrigation water. Sewage water contains higher concentrations of exchangeable cations compared to domestic water and this might have enhanced the mobile compound of the nutrients and made available to the plants and thereby enhancing the nutrient uptake by the plants. This is supported by the findings of Jothimani *et al.* (2002). Further, the interaction between sewage water and the applied nutrients had shown significant value indicating that the nutrients in the sewage water would have supplemented for improved soil fertility and availability to the plants as evidenced by Mojiri and Amirossadt (2011).

### *Post harvest soil nutrient availability*

The pooled data on post harvest soil available nutrients is presented in Fig.4. Irrigation with sewage water and integrated nutrient supply of organic and inorganic nutrients had significant influence on soil fertility status during experimentation. The treatments differed for the available nutrient status of the soil. Irrigation with normal water resulted in higher soil available macro nutrients and comparable with irrigation through sewage water and normal water alternatively. No application of nutrients for the fodder crops resulted in higher quantity of soil available nutrients followed by application of farm yard manure alone. The soil available nutrients was lesser with the application of recommended dose of organic and inorganic nutrients and followed by the application of inorganic nutrients alone. With respect to irrigation, the fodder crops irrigated with sewage water resulted in lesser quantity of soil available nutrients compare to the initial status of soil fertility. Mancino and Pepper (1992) and Abedi *et al*. (2006) reported the same results that the available nitrogen, phosphorous and potassium concentration increased significantly with sewage water application and application of nutrients. This might be due increase in soil organic matter, nitrogen and concentrations of major cations. This observation was in line with the findings of Angin *et al*. (2005). Similarly, as the mobile cations are more with sewage water application, the application of organic and inorganic nutrients would have improved the post harvest soil nutrient status of major nutrients. This agrees with the findings of Rana *et al.* (2010).

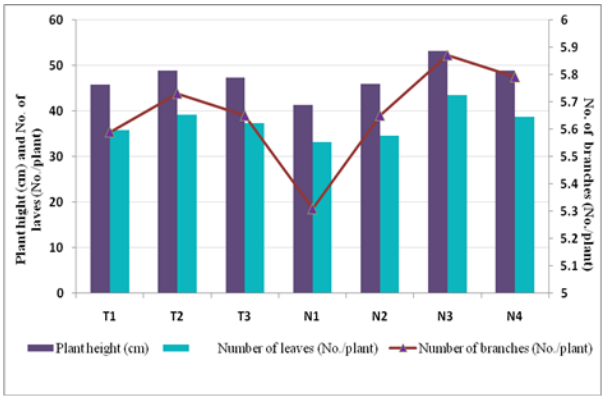


Figure 1. Effect of irrigation water and nutrients on growth of fodder cowpea

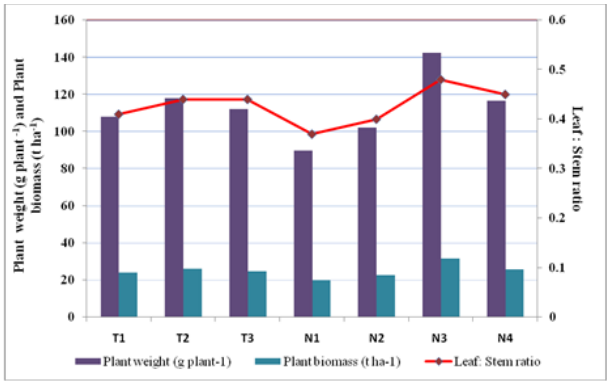


Figure 2. Effect of irrigation water and nutrients on yield of fodder cowpea

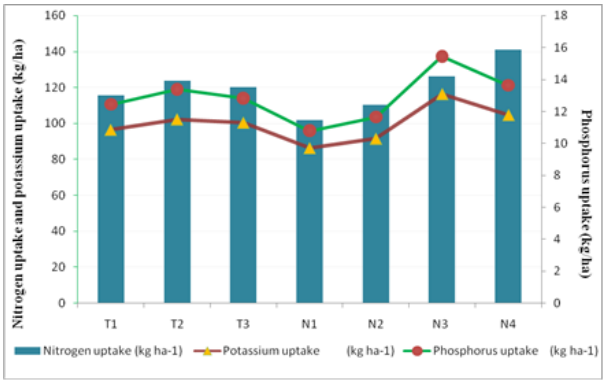


Figure 3. Effect of irrigation water and nutrients on nutrient uptake of fodder cowpea

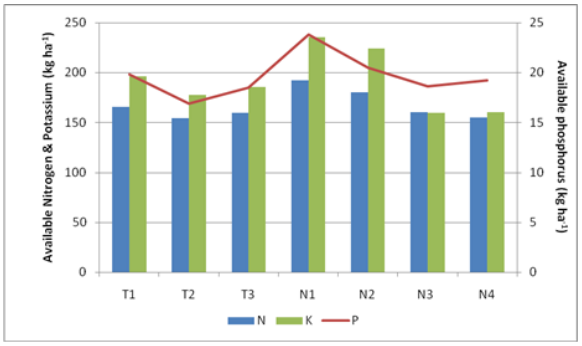


**Figure 4. Effect of irrigation water and nutrients on post harvest available nutrients after harvest of fodder cowpea**

## Conclusion

It is concluded from the study that application of sewage water along with the recommended dose of nutrients for fodder cowpea results in higher yield, nutrient uptake and soil available nutrients. The availability of higher nutrients in the fodder cowpea will definitely results in increased productivity of animals.

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