*Int.J.Curr.Microbiol.App.Sci* (2017) Special Issue-4: 25-29

EXCELLENT PUBLISHERS

*International Journal of Current Microbiology and Applied Sciences*
***ISSN: 2319-7706*** **Special Issue-4 (September-2017) pp. 25-29**
Journal homepage: http://www.ijcmas.com

## Original Research Article

# Evaluation of Nutrient Balance Sheet as Influenced by Drip Fertigation in Cauliflower

**Ajeet Singh[1*], S. K. Sharma[1], Rahul Chopra[1], S. C. Meena[1] and Hansram Mali[2]**

[1]Department of Agricultural Chemistry and Soil Science, RCA, MPUAT, Udaipur, Rajasthan 313001, India
[2]Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan 313001, India
**Corresponding author*

**Keywords**

Fertigation, N, P and K Balance Sheet

**A B S T R A C T**

Field experiments were conducted on cauliflower to investigation evaluation of nutrient balance sheet as influenced by drip fertigation in cauliflower at Horticulture Farm, Rajasthan College of Agriculture, MPUAT, Udaipur during the *Rabi* season in 2013-14 and 2014-15. The experiment was conducted in split plot design with three replications and fifteen treatments combination. Results showed that maximum expected balance of nitrogen (374.20 kg $ha^{-1}$), phosphorous (144.94 kg $ha^{-1}$) and potassium (264.7 kg $ha^{-1}$) were recorded under treatments combination $I_1F_1$ (80 % PE drip irrigation with 100 % RDF). The highest nutrient balance after harvest of the cauliflower was obtained at $F_1$ fertigation levels *i.e.* 100 per cent RDF at all the irrigation levels. However, N, P & K balance was minimum at 50 per cent RDF. Thus, 100 per cent RDF must be recommended to maintain soil fertility.

## Introduction

Water and nutrients play vital role in production and productivity of vegetable crop but continuous and imbalance use of fertilizer badly effect production potential and soil health. Hence, drip fertigation is such innovative technology of applying water soluble fertilizers through drip irrigation and uniform distribution of nutrients directly to root zone in available forms, control of nutrient concentration in soil solution and saving in application cost (Ready *et al.*, 2017). Nutrient balance sheets in most of the Indian soils have been show deficient due to continue crop removal of nutrients in the soil. This is primarily because nutrient removals by crops far exceed the nutrient additions through manures and fertilizers. For the past 50 years the gap between removals and additions has been estimated at 8 to 10 Mt $N+P_2O_5+K_2O$ per year (Tandon, 2004). This has been the case in the past, at present, and this will likely continue into the future. To this extent, the soils are becoming depleted – the situation is akin to mining soils of their nutrient capital, leading to a steady reduction in soil nutrient supplying capacity. On top of this deficit are the nutrient losses through various other means. For example, nutrient losses through soil erosion are alarmingly large, but are rarely taken into account. In the view of above mentioned considerations, this study was carried out to investigate the response of cauliflower for varying irrigation regimes and fertigation levels with modification in nutrients balance in the soil.

## Materials and Methods

The experiment was conducted at Horticulture Farm, Rajasthan College of Agriculture, MPUAT Udaipur during rabi season in 2013-14 and 2014-15.The site was situated at 24o.35' N latitude, 74o.42' E longitude and an altitude of 579.5 m above mean sea level. The region falls under agro-climatic zone IVA (Sub-Humid Southern Plain and Aravalli Hills) of Rajasthan. The soil was *Haplustepts*, clay loam in texture having pH 8.15, EC 0.67 dS $m^{-1}$, Organic carbon 0.71%, available nitrogen 296.45 kg $ha^{-1}$, available phosphorus 23.76 kg $ha^{-1}$ and available potassium 318.65 kg $ha^{-1}$. The experiment was laid out in split plot design with 15 treatment combinations which consisted of 3 levels of drip irrigation (80%, 60% and 40% PE) and 5 levels of fertigation (100% RDF, 75% RDF, 50% RDF, 75% RDF + 2 foliar spray 1% urea phosphate, and 50% RDF + 2 foliar spray 1% urea phosphate through fertigation) were replicated three times. Seedlings of cauliflower variety Pusa Snowbal K-1 was transplanted during third week of November and harvested in the third week of February. The water soluble fertilizers (urea, urea phosphate and potassium nitrate) were used in experiment through drip irrigation. The fertilizers were applied at fifteen days interval in 6 equal splits starting from 15 days after transplanting through drip irrigation according to fertilizer schedules. The fertilizer schedules was developed according to RDF (120-80-60 NPK kg $ha^{-1}$) for cauliflower crop. In drip irrigation scheduling was done based on pan evaporation and application of water three days interval according to requirement of the crop.

## Soil Nutrient Balance Sheets

An assessment of nutrient additions, removals, and balances in the agricultural production system generates useful, practical information on whether the nutrient status of a soil (or area) is being maintained, built up, or depleted. A simplified depiction of nutrient additions and removals is given in Figure 1.

## Results and Discussion

### Effect on nutrient balance after harvest of crop

Data pertaining to the nutrient balance *i.e.* nitrogen, phosphorus and potassium after harvest of cauliflower for two year experiment summarized in table 1 to 3.

### Nitrogen balance

Perusal of data presented in table 1 showed that positive effect of 100 % RDF through drip irrigation applied on nitrogen balance sheet. It is evident from the data that net gain of nitrogen varies from 10.72 to 53.60 kg N $ha^{-1}$ under different treatments. The highest net gain 53.60 kg $ha^{-1}$ was recorded with $I_1F_1$ treatment followed by 40.23 and 38.78 kg N $ha^{-1}$ under $I_2F_1$ and $I_3F_{1,}$ respectively. Further, the net nitrogen values was less as compare to other treatments under $F_3$ *i.e.* 50% RDF application at all three levels of irrigation. These findings confirm those of Raju and Reddy (2000) and Jeyaselvin Inbaraj (1995).

### Phosphorus balance

A critical examination of data presented in table 2 reveled that net gain of phosphorus varies from 1.90 to 6.79 kg $P_2O_5$ $ha^{-1}$ under different treatments.

**Fig.1** A simplified presentation of nutrient additions and removals in agricultural soils (Smaling, 1993)

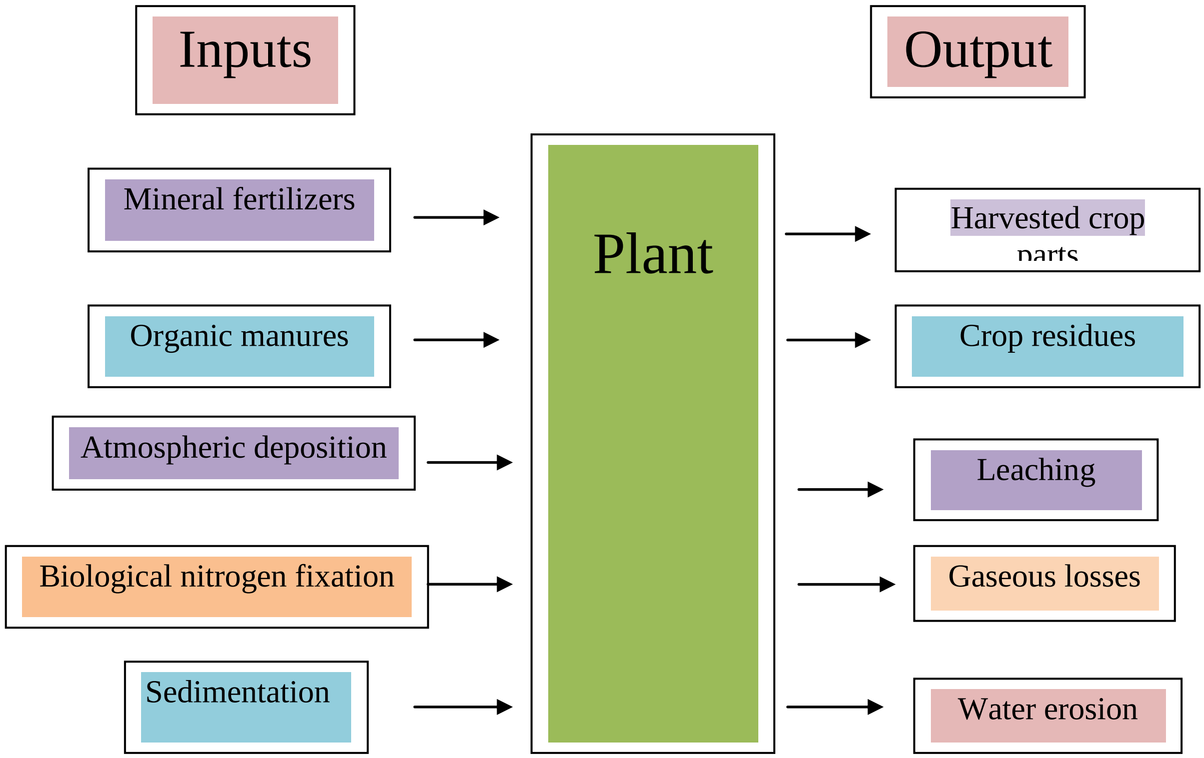


**Table.1** Effect of drip irrigation and fertigation levels on nitrogen balance sheet after harvest of two cycles of cauliflower

| **Treatments** | **Initial soil N status (kg ha$^{-1}$)** | **Added N through fertilizer (kg ha$^{-1}$)** | **N uptake (kg ha$^{-1}$)** | **Expected balance in soil {(A+B)-C}** | **Actual soil fertility status** | **Apparent gain (E-D) or loss (D-E)** | **Net gain (E-A) or loss (A-E)** |
|---|---|---|---|---|---|---|---|
| | **A** | **B** | **C** | **D** | **E** | **F** | **G** |
| I1F1 | 287.32 | 240.0 | 205.85 | 321.47 | 340.92 | 19.45 | 53.60 |
| I1F2 | 287.32 | 180.0 | 185.77 | 281.55 | 311.30 | 29.76 | 23.98 |
| I1F3 | 287.32 | 120.0 | 146.59 | 260.73 | 298.04 | 37.31 | 10.72 |
| I1F4 | 287.32 | 182.0 | 223.72 | 245.60 | 317.48 | 71.88 | 30.16 |
| I1F5 | 287.32 | 122.0 | 173.16 | 236.16 | 309.73 | 73.58 | 22.41 |
| I2F1 | 287.32 | 240.0 | 194.27 | 333.05 | 327.55 | -5.50 | 40.23 |
| I2F2 | 287.32 | 180.0 | 180.65 | 286.67 | 321.08 | 34.41 | 33.76 |
| I2F3 | 287.32 | 120.0 | 126.99 | 280.33 | 299.79 | 19.46 | 12.47 |
| I2F4 | 287.32 | 182.0 | 194.76 | 274.56 | 312.87 | 38.31 | 25.55 |
| I2F5 | 287.32 | 122.0 | 137.63 | 271.69 | 309.88 | 38.20 | 22.56 |
| I3F1 | 287.32 | 240.0 | 153.12 | 374.20 | 326.10 | -48.10 | 38.78 |
| I3F2 | 287.32 | 180.0 | 131.78 | 335.54 | 314.49 | -21.05 | 27.17 |
| I3F3 | 287.32 | 120.0 | 120.95 | 286.37 | 301.01 | 14.64 | 13.69 |
| I3F4 | 287.32 | 182.0 | 155.34 | 313.98 | 321.21 | 7.23 | 33.89 |
| I3F5 | 287.32 | 122.0 | 125.64 | 283.68 | 305.92 | 22.24 | 18.60 |

**Table.2** Effect of drip irrigation and fertigation levels on phosphorus balance sheet after harvest of two cycles of cauliflower

| Treatments | Initial soil P status (kg $ha^{-1}$) | Added P through fertilizer (kg $ha^{-1}$) | P uptake (kg $ha^{-1}$) | Expected balance in soil {(A+B)- C} | Actual soil fertility status | Apparent gain (E-D) or loss (D-E) | Net gain (E-A) or loss (A-E) |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G |
| I1F1 | 22.05 | 160.0 | 56.59 | 125.46 | 28.84 | -96.62 | 6.79 |
| I1F2 | 22.05 | 120.0 | 46.30 | 95.75 | 26.39 | -69.35 | 4.34 |
| I1F3 | 22.05 | 80.0 | 35.21 | 66.84 | 24.12 | -42.72 | 2.07 |
| I1F4 | 22.05 | 122.0 | 60.32 | 83.73 | 26.77 | -56.96 | 4.72 |
| I1F5 | 22.05 | 82.0 | 42.54 | 61.51 | 24.82 | -36.69 | 2.77 |
| I2F1 | 22.05 | 160.0 | 50.33 | 131.72 | 28.10 | -103.62 | 6.05 |
| I2F2 | 22.05 | 120.0 | 42.75 | 99.30 | 25.85 | -73.45 | 3.80 |
| I2F3 | 22.05 | 80.0 | 29.33 | 72.72 | 25.02 | -47.70 | 2.97 |
| I2F4 | 22.05 | 122.0 | 50.90 | 93.15 | 27.35 | -65.80 | 5.30 |
| I2F5 | 22.05 | 82.0 | 32.92 | 71.13 | 25.21 | -45.92 | 3.16 |
| I3F1 | 22.05 | 160.0 | 37.11 | 144.94 | 27.52 | -117.42 | 5.47 |
| I3F2 | 22.05 | 120.0 | 32.51 | 109.54 | 26.02 | -83.52 | 3.97 |
| I3F3 | 22.05 | 80.0 | 26.14 | 75.91 | 23.95 | -51.96 | 1.90 |
| I3F4 | 22.05 | 122.0 | 38.07 | 105.98 | 26.44 | -79.54 | 4.39 |
| I3F5 | 22.05 | 82.0 | 28.90 | 75.15 | 25.35 | -49.80 | 3.30 |

**Table.3** Effect of drip irrigation and fertigation levels on potassium balance sheet after harvest of two cycles of cauliflower

| Treatments | Initial soil K status (kg $ha^{-1}$) | Added K through fertilizer (kg $ha^{-1}$) | K uptake (kg $ha^{-1}$) | Expected balance in soil {(A+B)- C} | Actual soil fertility status | Apparent gain (E-D) or loss (D-E) | Net gain (E-A) or loss (A-E) |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G |
| I1F1 | 312.21 | 120.0 | 243.46 | 188.75 | 340.21 | 151.46 | 28.00 |
| I1F2 | 312.21 | 90.0 | 211.28 | 190.93 | 330.92 | 139.99 | 18.71 |
| I1F3 | 312.21 | 60.0 | 162.21 | 210.00 | 322.45 | 112.45 | 10.24 |
| I1F4 | 312.21 | 90.0 | 250.65 | 151.56 | 338.32 | 186.76 | 26.11 |
| I1F5 | 312.21 | 60.0 | 189.50 | 182.71 | 323.51 | 140.80 | 11.30 |
| I2F1 | 312.21 | 120.0 | 219.13 | 213.08 | 337.43 | 124.36 | 25.22 |
| I2F2 | 312.21 | 90.0 | 200.01 | 202.20 | 325.88 | 123.68 | 13.67 |
| I2F3 | 312.21 | 60.0 | 143.72 | 228.49 | 319.21 | 90.72 | 7.00 |
| I2F4 | 312.21 | 90.0 | 222.77 | 179.44 | 331.67 | 152.23 | 19.46 |
| I2F5 | 312.21 | 60.0 | 151.56 | 220.65 | 322.32 | 101.67 | 10.11 |
| I3F1 | 312.21 | 120.0 | 167.50 | 264.71 | 332.76 | 68.05 | 20.55 |
| I3F2 | 312.21 | 90.0 | 149.63 | 252.58 | 326.32 | 73.74 | 14.11 |
| I3F3 | 312.21 | 60.0 | 133.50 | 238.71 | 321.34 | 82.63 | 9.13 |
| I3F4 | 312.21 | 90.0 | 176.27 | 225.94 | 327.21 | 101.27 | 15.00 |
| I3F5 | 312.21 | 60.0 | 143.24 | 228.97 | 323.21 | 94.24 | 11.00 |

The highest net gain 6.79 kg $P_2O_5$ $ha^{-1}$ was found and $I_1F_1$ treatment followed by 6.05 and 5.47 kg $P_2O_5$ $ha^{-1}$ under $I_2F_1$ and $I_3F_1$, respectively. Further, the net phosphorus values was less as compare to other treatments under $F_3$ *i.e.* 50% RDF application at all three levels of irrigation. Nutrient supply through drip fertigation enabled greater uptake of P by cauliflower, reduce P fixation and the available balance after harvest of cauliflower was higher in all the levels of irrigation because incorporation of fertilizer through drip irrigation, reduces the nutrient loss in the soil and enhances the nutrient availability throughout the cropping period hence sustaining the P status of the soil. These findings were confirmed by Raju and Reddy (2000) and Senthivelu and Surya (2007).

## Potassium balance

A perusal of data summarized in the table 3 that net gain of potassium varies from 7.00 to 28.00 kg $K_2O$ $ha^{-1}$ under different treatments. The highest net gain 28.00 kg $K_2O$ $ha^{-1}$ was registered with $I_1F_1$ treatment followed by 25.55 and 20.55 kg $K_2O$ $ha^{-1}$ under $I_2F_1$ and $I_3F_1$, respectively.

Further, the net potassium values was less as compare to other treatments under $F_3$ *i.e.* 50% RDF application at all three levels of irrigation. However such nutrient practices supplied better availability of nutrients to cauliflower, higher uptake by crop and less nutrient loss in soil leads to positive balance of K after cauliflower harvest.

This statement was in confirmation with Jain and Meena (2015).

In this study it has been concluded that combined application of fertilizer and irrigation levels could be a sustainable practice to enhance nutrients balance in the soil and improved soil fertility.

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