***Original Research Article***

# Fertiliser recommendations for Pearl millet through Soil Test Crop Response-Integrated Plant Nutrition System approach on *Alfisol.*

.


## ABSTRACT

The field experiment was conducted in RBD with three replications at farmer's field which is located at Vagarai village, Dindigul district during February to May 2023 for refining the already existing Fertiliser Prescription Equations (FPEs) of hybrid pearl millet, which has been developed for Periyanaikenpalayam series to suit Palaviduthi soil series (*Typic Rhodustalf*). The performance of the pearl millet TNAU hybrid CO 10 was evaluated. The results of the experiment revealed that highest grain yield obtained from STCR - IPNS - 4.0 t $ha^{-1}$, where farmyard manure along with inorganic fertilisers were combinedly applied. From the experimental data, basic parameters *viz.,* nutrient requirement (NR), per cent contribution of nutrients from soil (Cs), fertilisers (Cf) and FYM (Cfym) were computed. It has been found that the nutrient requirement for producing one quintal grain of pearl millet was 2.23 kg of N, 1.19 kg of $P_2O_5$, and 2.22 kg of $K_2O$. The per cent contribution from soil (Cs) and fertilisers (Cf) were 15.7 and 47.1 for N, 32.09 and 45.06 for $P_2O_5$, 10.04 and 66.71 for $K_2O$ respectively. Per cent contribution from FYM was 36.09 for N, 16.84 for $P_2O_5$ and 33.29 for $K_2O$. FPEs for Pearl millet were generated using these basic parameters through the Soil Test Crop Response based Integrated Plant Nutrition System (STCR-IPNS). Applying FYM @ 12.5 t $ha^{-1}$ combined with NPK fertilisers, was projected to result in a saving of 40, 21, and 27 kilograms of fertiliser N, $P_2O_5$, and $K_2O$, respectively. Soil test-based fertiliser recommendations and integrated plant nutrient management will help farmers to conserve fertilisers as well as sustain soil health and high rates of productivity.



*Keywords: Pearl millet, Alfisol, Fertiliser prescriptions, STCR-IPNS*


## 1. INTRODUCTION

Around the world, the pearl millet is becoming more and more well-liked by those who are concerned with their health. It can be extremely important in preventing malnutrition and ensuring nutritional and food security. Pearl millet is recognized as a nutri-cereal (Gazette of India, No. 133, April 13, 2018) for production, consumption, trade, and inclusion in the public distribution system due to its superior nutritional qualities[4].The Indian government designated 2018 as the "Year of Millets," and the United Nations designated 2023 as the "International Year of Millets," to mainstream millets and capitalize on its nutritionally rich qualities while boosting their cultivation[2]. Bajra, or pearl millet, is a member of the Poaceae family of plants and is native to Africa. One of the main crops for coarse grains, pearl millet is regarded as a staple diet for working-class people because it contains more fibre and is healthy for diabetes and cardiac patients, The nutritional content of this crop opens up a lot of potential for the development of value-added goods in new customer categories who are health conscious [13]. Protein (11.6%), iron (8.8%), fat (5%) and carbohydrates (67%) are all abundant in its grains. In India, pearl millet was cultivated in 6.93 million ha. with 8.61 million tons production and 1243 kg $ha^{-1}$ of productivity during 2018-2019 [4]. In Tamil Nadu pearl millet was cultivated in 0.60 lakh ha with production of 1.57 lakh tones and productivity of

2616 kg $ha^{-1}$ during 2021-22 [23]. To meet the needs of an expanding population, modern agriculture heavily relies on inorganic fertiliser. Continuous application of inorganic fertilisers endangers the physical, chemical, and biological health of the soil. The population of beneficial organisms declines and the soil's ability to naturally regenerate nutrients stops, making it barren and infertile. Therefore, balanced use of fertilisers should be followed to decrease the environmental degradation without affecting the yield of the crop. One of the best ways to provide balanced fertilisation is through Soil Test Crop Response – Integrated Plant Nutrition System (STCR-IPNS), it is also known as targeted yield approach which not only indicates the amount of fertiliser based on the results of soil tests, but also the level of yield that may be obtained under the right management procedures for crop production. The targeted yield strategy also offers the scientific foundation for balanced fertilisation, which is based on both nutrients that are present in the soil and those that are applied as nutrients from external sources. Hence, an attempt was made to refine the already existing fertiliser prescription equations for pearl millet through STCR-IPNS approach for different yield targets on red non-calcareous soil (Palaviduthi series).

## 2. MATERIAL AND METHODS

The field experiment was carried out in a farmer's field which is located at Vagarai village of Dindigul district, using the experimental crop TNAU Pearl millet hybrid CO 10. The soil of the experimental field is red, non-calcareous, sandy loam, slightly alkaline (pH – 8.08), non-saline (EC – 0.06 dS $m^{-1}$), low in organic carbon (4 g $kg^{-1}$), low in available nitrogen (222 kg $ha^{-1}$), high in available phosphorus (25 kg $ha^{-1}$) and available potassium (330 kg $ha^{-1}$) and sufficient in Fe, Zn, Cu and Mn. The experiment was laid out in Randomized Block Design (RBD) consisting of eleven treatments which was replicated thrice. The treatments are $T_1$: Absolute control, $T_2$: FYM @ 6.25 t $ha^{-1}$, $T_3$: FYM @ 12.5 t $ha^{-1}$, $T_4$: NPK alone - 3 t $ha^{-1}$, $T_5$: NPK alone - 3.5 t $ha^{-1}$, $T_6$: NPK alone - 4 t $ha^{-1}$, $T_7$: IPNS - 3.0 t $ha^{-1}$, $T_8$: IPNS - 3.5 t $ha^{-1}$, $T_9$: IPNS - 4.0 t $ha^{-1}$, $T_{10}$: Blanket(100% RDF) and $T_{11}$: Blanket(100% RDF) + FYM @ 12.5 t $ha^{-1}$. Based on the initial soil test value of available N, P and K the doses of nutrients supplied to soils are calculated for STCR treatments based on the already existing fertiliser prescription equations which has been developed for *Inceptisol*. The quantities of N, P and K contributed through FYM was subtracted from inorganic fertilisers for STCR - IPNS treatments. The sources of nitrogen, phosphorus and potassium are urea, single super phosphate (SSP) and muriate of potash (MOP). For the treatments $T_4$ to $T_{11,}$ SSP and MOP are applied basally, and urea is applied in three splits @ 25: 50: 25 per cent at basal,15 and 30 DAS respectively. Soil samples were collected from each plot before imposing the treatments and analyzed for available N [11], P [12] and K [22]. When the crop reached maturity, it was harvested, and the yields of grain and straw were noted and the samples of grain and straw were analyzed for their N [5], P and K [6] contents. Uptake of N, P and K were calculated by multiplying the grain and straw yield with its respective nutrient content. The basic parameters *viz.,* Nutrient requirement (NR), Per cent contribution from soil (Cs), Per cent contribution from fertiliser (Cf) and Per cent contribution from farmyard manure (Cfym) were calculated with the data *viz.,* Initial available N, P and K status of the soil and doses of fertiliser applied, yield and total N, P and K uptake by pearl millet obtained from the Treatments 1 to 9 by adopting the methodology developed by [14]. By using these basic parameters fertiliser prescription equations were developed with and without FYM.

1. **Nutrient Requirement (NR in kg $q^{-1}$)**
   - i) Kg N required per quintal of grain production = Total upake of N (kg $ha^{-1}$) / Grain yield (q $ha^{-1}$)
   - ii) Kg $P_2O_5$ required per quintal of grain production = Total uptake of $P_2O_5$ (kg ha-$^{1}$) / Grain yield (q $ha^{-1}$)

iii) Kg $K_2O$ required per quintal of grain production = Total uptake of $K_2O$ (kg ha-$^{-1}$) / Grain yield (q ha$^{-1}$)

**2. Per cent contribution of nutrients from soil to total nutrient uptake (Cs)**

i) Per cent contribution of N from soil = [Total uptake of N in control plot (kg ha$^{-1}$) / Soil test value for available N in control plot (kg ha$^{-1}$)] x 100

ii) Per cent contribution of $P_2O_5$ from soil = [Total uptake of $P_2O_5$ in control plot (kg ha$^{-1}$) / Soil test value for available $P_2O_5$ in control plot (kg ha$^{-1}$)] x 100

iii) Per cent contribution of $K_2O$ from soil = [Total uptake of $K_2O$ in control plot (kg ha$^{-1}$) / Soil test value for available $K_2O$ in control plot (kg ha$^{-1}$)] x 100

**3. Per cent contribution of nutrients from fertilisers to total uptake (Cf)**

i) Per cent contribution of N from fertilisers = [Total uptake of N in treated plot (kg ha$^{-1}$) - (Soil test value for available N in treated plot (kg ha$^{-1}$) x Average Cs for N) / Fertiliser N applied (kg ha$^{-1}$)] x 100

ii) Per cent contribution of $P_2O_5$ from fertilisers = [Total uptake of $P_2O_5$ in treated plot (kg ha$^{-1}$) - (Soil test value for available $P_2O_5$ in treated plot (kg ha$^{-1}$) x Average Cs for $P_2O_5$) / Fertiliser $P_2O_5$ applied (kg ha$^{-1}$)] x 100

iii) Per cent contribution of $K_2O$ from fertilisers = [Total uptake of $K_2O$ in treated plot (kg ha$^{-1}$) - (Soil test value for available $K_2O$ in treated plot (kg ha$^{-1}$) x Average Cs for $K_2O$) / Fertiliser $K_2O$ applied (kg ha$^{-1}$)] x 100

**4. Per cent nutrient contribution of nutrients from organics to total uptake (Co)**

i) Per cent contribution from FYM (Cfym)

Cfym = [(Total uptake of N/$P_2O_5$/$K_2O$ in FYM treated plot (kg ha$^{-1}$) - (Soil test value for available N/$P_2O_5$/$K_2O$ in FYM treated plot (kg ha$^{-1}$) x Average Cs for N/$P_2O_5$/$K_2O$) / Nutrient N/$P_2O_5$/$K_2O$ added through FYM (kg ha$^{-1}$)] x 100

### 2.1 Fertiliser Prescription Equations

Making use of these basic parameters, the FPEs were developed as follows:

**i) Fertiliser Nitrogen (FN)**

$$FN = \frac{NR}{Cf}\ 100\ T - \frac{Cs}{Cf} SN$$

$$FN = \frac{NR}{Cf}\ 100\ T - \frac{Cs}{Cf} SN - \frac{Cfym}{Cf} ON$$

**ii) Fertiliser Phosphorus ($FP_2O_5$)**

$$FP_2O_5 = \frac{NR}{Cf}\ 100\ T - \frac{Cs}{Cf} \text{x } 2.29 \text{ x } SP$$

$$FP_2O_5 = \frac{NR}{Cf}\ 100\ T - \frac{Cs}{Cf} \text{x } 2.29 \text{ x } SP - \frac{Cfym}{Cf}\ \text{x } 2.29 \text{ x } OP$$

**iii) Fertiliser Potassium ($FK_2O$)**

$$FK_2O = \frac{NR}{Cf}\ 100\ T - \frac{Cs}{Cf} \text{x } 1.21 \text{ x } SK$$

$$FK_2O = \frac{\frac{NR}{Cf}}{100} T - \frac{Cs}{Cf} \text{x } 1.21 \text{ x } SK - \frac{Cfym}{Cf}\ \text{x } 1.21 \text{ x } OK$$

Where, FN: Fertiliser N (kg ha$^{-1}$); $FP_2O_5$: Fertiliser $P_2O_5$ (kg ha$^{-1}$); $FK_2O$: Fertiliser $K_2O$ (kg ha$^{-1}$); NR: Nutrient requirement of N or $P_2O_5$ or $K_2O$ (kg q$^{-1}$); Cs: Per cent contribution of nutrients from soil; Cf: Per cent contribution of nutrients from fertiliser; SN: Soil test value for available N (kg ha$^{-1}$); SP: Soil test value for available P (kg ha$^{-1}$); SK: Soil test value for

available K (kg $ha^{-1}$); Cfym: Per cent contribution of nutrients from FYM; ON: Quantity of N applied through FYM (kg $ha^{-1}$); OP: Quantity of P applied through FYM (kg $ha^{-1}$); OK: Quantity of K applied through FYM (kg $ha^{-1}$).
The above equations serve as a basis for prescribing fertiliser doses for specific yield targets of Pearl millet under IPNS for varied soil available nutrient levels.

## 3. RESULTS AND DISCUSSION

### 3.1 Grain yield

The range and mean values of grain yield of hybrid pearl millet are furnished in Table 1. Grain yield recorded due to imposition of different treatments ranged from 1130 kg $ha^{-1}$ to 3932 kg $ha^{-1}$. Among the treatments, $T_9$ (STCR-IPNS-4.0 t $ha^{-1}$) has recorded higher grain yield of about 3932 kg $ha^{-1}$ followed by $T_6$ (STCR-NPK-4.0 t $ha^{-1}$) with a grain yield of 3804 kg $ha^{-1}$. At all target levels, STCR – IPNS recorded higher yield than that of STCR-NPK alone. Similar trend of superiority was reported by Sharma and coworkers in pearl millet [20], Agila and coworkers in tomato [1], Sivaranjini and coworkers in maize [21] and Riya and coworkers in bhendi [17]. The yield advantage of STCR-IPNS over STCR-NPK was due to the addition of secondary and micronutrients by farmyard manure [9,3], Integrating the use of organic and inorganic nutrient sources is preferable to the use of inorganic fertiliser alone since STCR-IPNS treatments resulted in greater yields than STCR-NPK alone treatments. Next to $T_9$ and $T_6$, significantly higher yield was recorded in $T_8$ (STCR-IPNS-3.5 t $ha^{-1}$) with grain yield of 3432 kg $ha^{-1}$ followed by $T_5$ (STCR-NPK alone - 3.5 t $ha^{-1}$) which was on par with $T_{11}$ (Blanket + FYM) with grain yield of 3276 kg $ha^{-1}$ and 3228 kg $ha^{-1}$, respectively. The lowest grain yield was recorded in $T_1$ (Absolute control) with a grain yield of 1130 kg $ha^{-1}$.

### 3.2 Nutrient uptake

The N, P and K uptake of pearl millet ranged from 35.32 to 75.80 kg $ha^{-1}$, 8.66 to 17.21 kg $ha^{-1}$ and 33.22 to 63.30 kg $ha^{-1}$ respectively. The uptake of N, P and K of pearl millet was found significantly higher in all the treatments over absolute control. The highest uptake of N, P and K was found in $T_9$ (STCR-IPNS-4.0 t $ha^{-1}$) with 75.80, 17.21 and 63.30 kg $ha^{-1}$ respectively followed by $T_6$ (NPK alone-4.0 t $ha^{-1}$) with 73.17, 16.84 and 58.56 kg $ha^{-1}$ respectively. The outcomes amply demonstrated the reliability of the fertiliser recommendations based on the soil test for sustaining targeted grain yields. In treatments where FYM was added to fertilisers, plants also exhibited a stronger trend in their uptake of N, P, and K. This may be related to the mobilization and accumulation of nutrients to various sections of the plant, as well as the solubilization of native nutrients and chelation of nutrients with FYM. Absolute control recorded the lowest N, P and K uptake of 35.32, 8.66 and 33.22 kg $ha^{-1}$. Similar results were also reported by [25] and [7].

### 3.3 Response

An essential phenomenon to consider when deciding how to optimise nutrients is the response to applied fertiliser nutrients. The functional link between an increase in crop output and added fertilisers serves as a marker for fertiliser response. By comparing the differences between grain yield under absolute control and grain yield under various treatments, response has been calculated. The response of hybrid pearl millet ranged from 780 kg $ha^{-1}$ in $T_2$ (FYM @ 6.25 t $ha^{-1}$) to 2802 kg $ha^{-1}$ in $T_9$ (STCR-IPNS-4.0 t $ha^{-1}$). The data demonstrated a progressive rise in response from lower target to higher target regardless of STCR-NPK alone or STCR-IPNS, and the degree of response was greater under STCR-

IPNS than under STCR-NPK alone treatments. Similar trend in the response was reported by [16] in pearl millet and [18] in blackgram.

**Table.1 Mean and range of grain yield, pre-sowing soil test values and NPK uptake by Pearl millet**

| TREATMENTS | Grain Yield | UN | UP | UK | SN | SP | SK | FN | $FP_2O_5$ | $FK_2O$ | FYM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg $ha^{-1}$ | | | | | | | | | | t $ha^{-1}$ |
| $T_1$ Absolute control | 1130 | 35.32 | 8.66 | 33.22 | 225 | 27 | 331 | 0 | 0 | 0 | 0 |
| $T_2$ FYM alone @ 6.25 t $ha^{-1}$ | 1910 | 45.16 | 9.63 | 41.22 | 220 | 24 | 329 | 0 | 0 | 0 | 6.25 |
| $T_3$ FYM alone @ 12.5 t $ha^{-1}$ | 2212 | 51.63 | 11.91 | 41.45 | 226 | 23 | 328 | 0 | 0 | 0 | 12.5 |
| $T_4$ STCR - NPK alone - 3.0 t $ha^{-1}$ | 2740 | 62.83 | 14.38 | 44.21 | 224 | 28 | 333 | 72 | 42 | 43 | 0 |
| $T_5$ STCR - NPK alone - 3.5 t $ha^{-1}$ | 3276 | 65.54 | 15.52 | 52.43 | 222 | 25 | 327 | 103 | 56 | 59 | 0 |
| $T_6$ STCR - NPK alone - 4.0 t $ha^{-1}$ | 3804 | 73.17 | 16.84 | 58.56 | 225 | 23 | 330 | 120** | 60** | 60** | 0 |
| $T_7$ STCR-IPNS - 3.0 t $ha^{-1}$ | 2900 | 62.22 | 14.82 | 46.20 | 219 | 27 | 332 | 32 | 20* | 20* | 12.5 |
| $T_8$ STCR-IPNS – 3.5 t $ha^{-1}$ | 3432 | 67.67 | 16.22 | 55.12 | 221 | 26 | 328 | 63 | 32 | 31 | 12.5 |
| $T_9$ STCR-IPNS – 4.0 t $ha^{-1}$ | 3932 | 75.81 | 17.21 | 63.30 | 225 | 24 | 331 | 93 | 46 | 47 | 12.5 |
| $T_{10}$ Blanket (100% RDF) | 2665 | 58.12 | 13.25 | 41.82 | 218 | 26 | 329 | 80 | 40 | 40 | 0 |
| $T_{11}$ Blanket (100% RDF)+ FYM @12.5 t $ha^{-1}$ | 3228 | 65.28 | 15.15 | 52.28 | 223 | 25 | 332 | 80 | 40 | 40 | 12.5 |
| Range | 1130-3932 | 35.32-75.81 | 8.66-17.21 | 33.22-63.30 | 218-226 | 23-28 | 327-333 | | | | |
| Mean | 2839 | 60.25 | 13.96 | 48.16 | 223 | 25 | 330 | | | | |
| Sed | 48.68 | 2.45 | 1.28 | 2.07 | | | | | | | |
| CD (P=0.05) | 102 | 5.11 | 2.67 | 4.32 | | | | | | | |

Note: UN, UP & UK: Total uptake of N, P and K; SN, SP & SK are soil available N, P and K; FN $FP_2O_5$ & $FK_2O$ are fertiliser N, $P_2O_5$ and $K_2O$ applied.

### 3.4 Basic parameters

Using the pre-sowing soil available N, P and K, applied fertiliser doses, grain yield and NPK uptake obtained from the experiment, the basic parameters *viz.,* nutrient requirement (NR), contribution of nutrients from soil (Cs), fertilizers (Cf) and FYM (Cfym) were computed (Table 2). The findings of the current experiment showed that pearl millet TNAU hybrid CO 10 requires 2.23 kg N, 1.19 kg $P_2O_5$ and 2.22 kg $K_2O$ for producing one quintal of grain (Fig 1). The N requirement was relatively higher followed by $K_2O$ and $P_2O_5$. The order of nutrient requirement was similar to results of [15] in pea. The per cent contribution of nutrients from soil and fertilisers were 15.70 and 47.10 for N, 32.09 and 45.06 for $P_2O_5$ and 10.04 and 66.71 for $K_2O$. The per cent contribution of nutrients from FYM was 36.09, 16.84 and 33.29 for N, $P_2O_5$ and $K_2O$ respectively. (Fig 2). When it comes to the contribution of nutrients from soil, P was comparatively more abundant, followed by N and K. An increase in soil P supply was by a factor of 2.04 times N and 3.2 times $K_2O$. The per cent contribution of nutrients from fertilisers was higher in $K_2O$ N and $P_2O_5$. The current study's rise in the contribution of nutrients from fertiliser was consistent with findings presented by Mohamed and coworkers in finger millet [10]. The estimated per cent contribution of N, $P_2O_5$ and $K_2O$ from FYM (Cfym) were 36.09, 16.84 and 33.39 respectively for hybrid pearl millet which indicated that relatively higher contribution was recorded for N and $K_2O$ followed by $P_2O_5$. Similar findings were reported by Lalitha and coworkers in greengram [8].



**Table 2. Basic parameters**

| Basic parameters | N | $P_2O_5$ | $K_2O$ |
|---|---|---|---|
| NR (kg $q^{-1}$) | 2.23 | 1.19 | 2.22 |
| Cs (%) | 15.70 | 32.09 | 10.04 |
| Cf (%) | 47.10 | 45.06 | 66.71 |
| Cfym (%) | 36.09 | 16.84 | 33.29 |

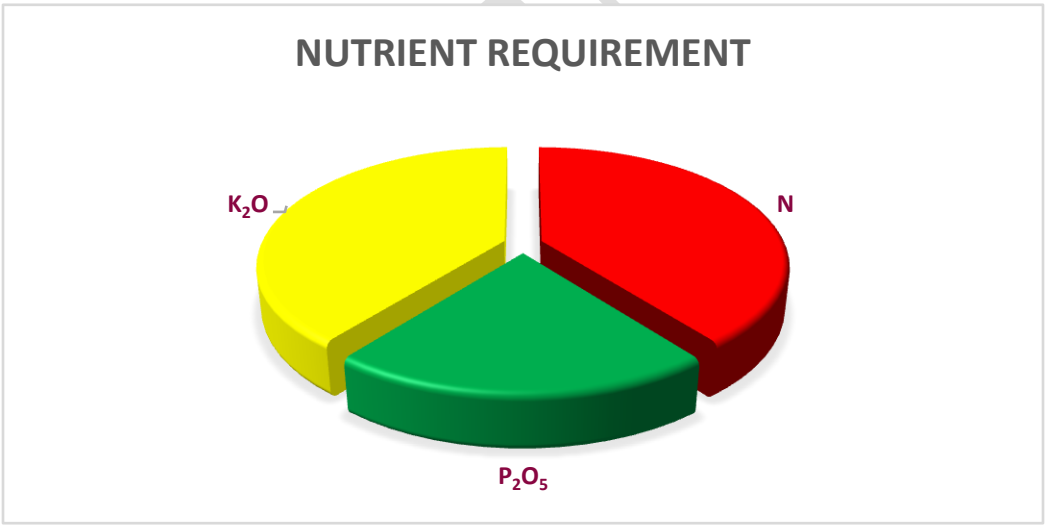


**Fig.1. Nutrient Requirement (NR-kg $q^{-1}$)**

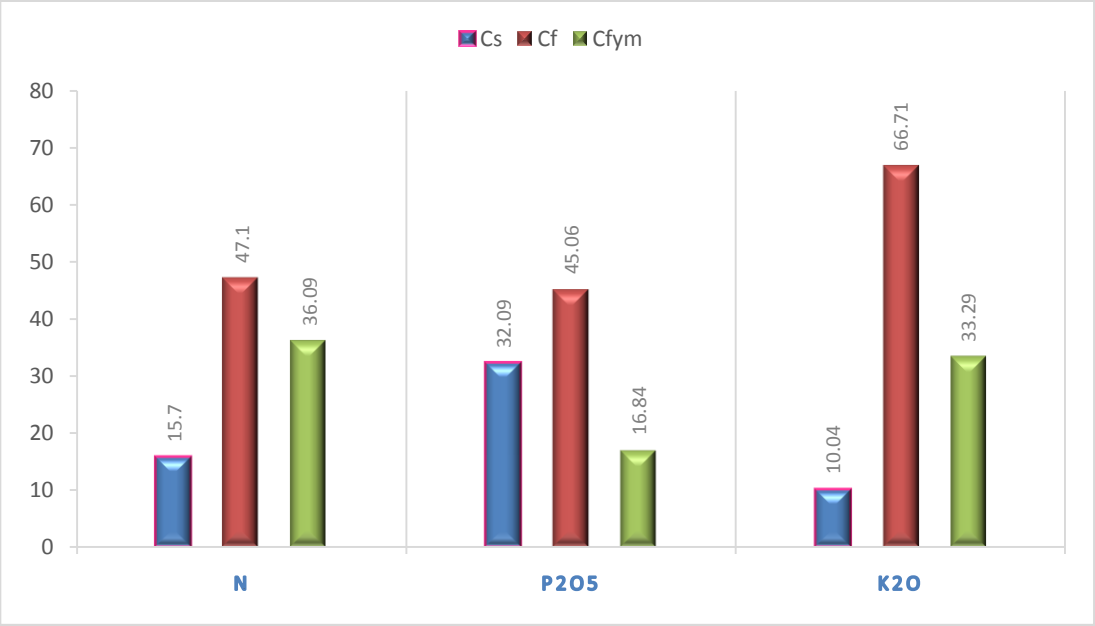


**Fig.2.Contribution of nutrients from soil (Cs), fertilizer (Cf), and (Cfym)**

### 3.5 Fertiliser prescription equations for blackgram under *Typic Rhodustalf*

**Table 3. The basic parameters NR, Cs, Cf and Cfym were used to generate fertiliser prescription equations under STCR - NPK alone and STCR - IPNS for pearl millet.**

| **STCR-NPK** | **STCR-NPK+FYM** |
|---|---|
| FN = 4.74 T – 0.33 SN | FN = 4.74 T – 0.33 SN – 0.77 ON |
| $FP_2O_5$ = 2.64 T – 1.63 SP | $FP_2O_5$ = 2.64 T – 1.63 SP – 0.86 OP |
| $FK_2O$ = 3.33 T – 0.18 SK | $FK_2O$ = 3.33T – 0.18 SK – 0.60 OK |

Where, FN, $FP_2O_5$ and $FK_2O$ are fertilisers N, $P_2O_5$ and $K_2O$ in kg $ha^{-1}$ respectively;T: Grain yield target in q $ha^{-1}$; SN, SP and SK are available N, P and K through soil in kg $ha^{-1}$, respectively; ON, OP and OK are N, P and K supplied through FYM in kg $ha^{-1}$.

### 3.6 Fertiliser prescriptions for pearl millet

Fertiliser Prescription Equations which have been developed for pearl millet on *Alfisol* were used to develop a ready reckoner for a range of soil test values for the desired yield targets of 3.0, 3.5 and 4.0 t $ha^{-1}$. Fertiliser prescriptions for both NPK alone and IPNS were computed and presented (Tables 4-6). With the soil test values of 222, 25 and 330 kg $ha^{-1}$ of $KMnO_4$-N, Olsen P and $NH_4OAc$-K, fertiliser prescriptions were calculated with the yield target of 3.0, 3.5 and 4.0 t $ha^{-1}$. The calculated fertiliser doses of N, $P_2O_5$ and $K_2O$ for NPK alone was 68: 38: 41, 91: 52: 57 and 113:65:74 Kg $ha^{-1}$ for yield targets of 3.0, 3.5 and 4 t $ha^{-1}$ respectively. When 12.5 t $ha^{-1}$ of FYM (with 26% moisture, 0.56%N, 0.27% P and 0.49% K) was applied in STCR-IPNS treatments, the fertiliser N, $P_2O_5$ and $K_2O$ reduced was 40, 21 and 27 kg $ha^{-1}$ respectively. The amount of fertiliser used increased when yield targets were high and reduced in soils with high nutrient availability. Similar trends were also observed in [26], [11] and [19].

**Table 4. Ready reckoner of fertiliser doses for STCR -NPK alone, STCR-IPNS (FYM) for desired yield target of 3.0 t ha$^{-1}$ for Pearl millet**

| Soil Test Value (kg ha$^{-1}$) | Treatments | | |
|---|---|---|---|
| | STCR –NPK Alone | STCR –IPNS | Percent reduction due to IPNS over STCR-NPK alone |
| **$KMnO_4$ - N** | | | |
| 200 | 76 | 40* | 47.4 |
| 220 | 70 | 40* | 42.9 |
| 240 | 63 | 40* | 36.5 |
| 260 | 56 | 40* | 28.6 |
| 280 | 50 | 40* | 20.0 |
| 300 | 43 | 40* | 7.0 |
| **Olsen – P** | | | |
| 16 | 53 | 32 | 39.6 |
| 18 | 50 | 29 | 42.0 |
| 20 | 47 | 26 | 44.7 |
| 22 | 43 | 22 | 48.8 |
| 24 | 40 | 20* | 50 |
| 26 | 37 | 20* | 45.9 |
| **$NH_4OAc$ – K** | | | |
| 300 | 46 | 20* | 56.5 |
| 320 | 42 | 20* | 52.4 |
| 340 | 39 | 20* | 48.7 |
| 360 | 35 | 20* | 42.9 |
| 380 | 32 | 20* | 37.5 |
| 400 | 28 | 20* | 28.6 |

*(NB: * maintenance dose)*

- Blanket dose: 80:40: 40 kg ha$^{-1}$ of fertiliser N, $P_2O_5$& $K_2O$ respectively for pearl millet (hybrids)
- If the calculated fertiliser dose tends to fall below 50 per cent of the blanket, a maintenance dose of 50 per cent of the blanket is recommended.

- If the calculated dose exceeds 150 per cent of the blanket, a maximum dose of 150 per cent of the blanket is recommended for N, $P_2O_5$& $K_2O$ respectively.

**Table 5. Ready reckoner of fertiliser doses for STCR-NPK alone, STCR-IPNS (FYM) for desired yield target of 3.5 t $ha^{-1}$ for Pearl millet**

| Soil Test Value (kg $ha^{-1}$) | Treatments | | |
|---|---|---|---|
| | STCR-NPK Alone | STCR-IPNS | Percent reduction due to IPNS over STCR-NPK alone |
| **$KMnO_4$ - N** | | | |
| 200 | 100 | 60 | 40.0 |
| 220 | 93 | 53 | 43.0 |
| 240 | 87 | 47 | 46.0 |
| 260 | 80 | 40 | 50.0 |
| 280 | 74 | 34 | 54.1 |
| 300 | 67 | 27 | 59.7 |
| **Olsen – P** | | | |
| 16 | 60** | 45 | 25.0 |
| 18 | 60** | 42 | 30.0 |
| 20 | 60 | 39 | 35.0 |
| 22 | 57 | 36 | 36.8 |
| 24 | 53 | 32 | 39.6 |
| 26 | 50 | 29 | 42.0 |
| **$NH_4OAc$ – K** | | | |
| 300 | 60** | 36 | 40.0 |
| 320 | 59 | 32 | 45.8 |
| 340 | 55 | 28 | 49.1 |
| 360 | 52 | 25 | 52.0 |
| 380 | 48 | 21 | 56.3 |
| 400 | 45 | 20* | 55.6 |

*(NB: ** maximum dose)*

- Blanket dose: 80:40: 40 kg $ha^{-1}$ of fertiliser N, $P_2O_5$& $K_2O$ respectively for pearl millet (hybrids)
- If the calculated fertiliser dose tends to fall below 50 per cent of the blanket, a maintenance dose of 50 per cent of the blanket is recommended.
- If the calculated dose exceeds 150 per cent of the blanket, a maximum dose of 150 per cent of the blanket is recommended for N, $P_2O_5$& $K_2O$ respectively.

**Table 6. Ready reckoner of fertiliser doses for STCR -NPK alone, STCR-IPNS (FYM) for desired yield target of 4.0 t $ha^{-1}$ for Pearl millet**

| Soil Test Value ($kg\ ha^{-1}$) | Treatments | | |
|---|---|---|---|
| | STCR –NPK Alone | STCR –IPNS | Percent reduction due to IPNS over STCR-NPK alone |
| **$KMnO_4$ - N** | | | |
| 200 | 120** | 84 | 30.0 |
| 220 | 117 | 77 | 34.2 |
| 240 | 110 | 70 | 36.4 |
| 260 | 104 | 64 | 38.5 |
| 280 | 97 | 57 | 41.2 |
| 300 | 91 | 51 | 44.0 |
| **Olsen – P** | | | |
| 16 | 60** | 59 | 1.7 |
| 18 | 60** | 55 | 8.3 |
| 20 | 60** | 52 | 13.3 |
| 22 | 60** | 49 | 18.3 |
| 24 | 60** | 45 | 25 |
| 26 | 60** | 42 | 30 |
| **$NH_4OAc$ – K** | | | |
| 300 | 60** | 52 | 13.3 |
| 320 | 60** | 49 | 18.3 |
| 340 | 60** | 45 | 25.0 |
| 360 | 60** | 41 | 31.7 |

| | | | |
|---|---|---|---|
| 380 | 60** | 38 | 36.7 |
| 400 | 60** | 34 | 43.3 |

*(NB: ** maximum dose; *maintenance dose)*

- Blanket dose: 80:40: 40 kg $ha^{-1}$ of fertiliser N, $P_2O_5$& $K_2O$ respectively for pearl millet (hybrids)
- If the calculated fertiliser dose tends to fall below 50 per cent of the blanket, a maintenance dose of 50 per cent of the blanket is recommended.
- If the calculated dose exceeds 150 per cent of the blanket, a maximum dose of 150 per cent of the blanket is recommended for N, $P_2O_5$& $K_2O$ respectively.

## 4. CONCLUSION

The Soil Test Crop Response based Integrated Plant Nutrition System for pearl millet has been developed in the present study on *Typic Rhodustalf* (red, non-calcareous, Palaviduthi soil series) of Tamil Nadu. From the results it was clear that there was a balance between the applied fertiliser nutrients and the nutrients already present in the soil. The organic fertiliser enhances a soil's physical, chemical, and biological qualities but the nutrients may not be as easily accessible to the plants. However, inorganic fertiliser is typically available quickly and contains all the nutrients that are required by plants. The integrated soil fertility management system is an alternative strategy for the efficient and cost-effective control of soil fertility and is characterised by a decreased input of inorganic fertilisers and the combination of inorganic and organic manures. The nutrient uptake was higher when organic manures and inorganic fertilisers were used together than when either organic or inorganic fertilisers were used alone, or when no fertilisers were used. In addition to ensuring sustainable crop output, target yield equations created using STCR-IPNS expertise also assure the economical application of expensive fertilisers. Hence, this approach is considered as one of the best approaches to improve farmer's income.



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