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# Residual effect of tillage, organics and seeding method on yield and nutrient uptake by safflower under sorghum-safflower cropping system

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## ABSTRACT

**The residual effect of different tillage and organics on yield and nutrient uptake and seeding method of succeeding crop was studied in field. Tillage organics showed significant residual effect on safflower. Direct seeding also showed significant and positive effect on safflower. Tillage with tractor plough ($T_3$), PMC @ 5 mg ha$^{-1}$ ($A_2$) and pulverization by rotavation ($P_2$) and direct seeding method ($S_2$) recorded maximum grain and straw yield of safflower. Similar trend was observed with respect to N, P and K uptake by grain and straw of safflower.**

**Key words :** Tillage, Organics, Residual effect, Seeding method, Safflower

## INTRODUCTION

The cropping system research was mostly focused on evaluation efficient crops and their varieties for specific agro-ecological units. In semi-arid tropics, the cropping systems in vogue are sequential, relay, ratoon and intercropping. Kanwar (1994) described the guidelines for potential cropping systems based on rainfall, broad soil group and effective growing period where sequential cropping is a viable and profitable proposition for 750-1000 mm rainfall region under vertisols and associated soil with 25-30 weeks effective growing period and cotton and sorghum as major crops of region. Sorghum-safflower are though recommended sequential cropping systems for vertisols and associated soils, no soil nutrient management models are developed through integrated plant nutrient supply, use of crop residues, press mud compost and soil mechanization. Considering these referred gaps in soil-nutrient availability, soil tillage and organic research, the present investigation was undertaken; as such type of information is scarcely available in the literature.

## MATERIALS AND METHODS

A field experiment was conducted at Agronomy farm, Marathwada Agricultural University, Parbhani during 1998-99 and 1999-2000 using *Kharif* sorghum and succeeding rain fed safflower. The experimental soil had pH (7.97), EC (0.38 dsm$^{-1}$), organic carbon (4.2 gkg$^{-1}$), available nitrogen (196.0 kgha$^{-1}$), available phosphorus (12.78 kg ha$^{-1}$) and available potassium (356.68 kg ha$^{-1}$). The tillage treatments consisted of tillage with low weight wooden plough ($T_1$), tillage with heavy weight mould board plough ($T_2$) and tillage with tractor plough ($T_3$). The organic amendment treatments, consisting of control ($A_1$) and application of 5 Mgha$^{-1}$ press mud compost ($A_2$) and farm yard manure ($A_3$), two levels of pulverization ($P_1$-two harrowing and $P_2$- one rotavation) and seeding method of safflower consisting of two harrowing after harvest of sorghum ($S_1$) and direct seeding of safflower ($S_2$). The experiment was laid out in FRBD with thirty six-treatment combination replicated four times. The tillage, organics and pulverization treatments were applied to *Kharif* sorghum. On the same site, safflower was grown after harvest of sorghum in *Rabi* season consisting of two treatments of seeding method (two harrowing after harvest of sorghum and direct seeding of safflower). The recommended doses of N, P and K were applied to safflower. The fertilizers used were urea, single super phosphate and murate of potash. The safflower cultivars sharda was sown after *Kharif* sorghum. Grain and straw yields were recorded from each plot at harvest. The plant samples were collected after harvest of safflower and analyzed for N, P and K content by standard methods (Piper, 1966 and Jackson, 1973).

## RESULTS AND DISCUSSION

The results obtained from the present investigation are summarized below :

### *Grain and straw yield :*

The data on grain and straw yield of safflower as influenced by residual effect various tillage and organic amendment treatments applied to *Kharif* sorghum and

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seeding method of safflower is presented in Table 1. The results revealed that the tillage with tractor plough ($T_3$) significantly increased the grain (571.16 and 523.41 kg ha$^{-1}$) and straw (1974.06 and 1789.91 kgha$^{-1}$) yield in both the years of study, respectively. This was followed by the treatment tillage with heavy weight mould board plough ($T_2$), which recorded 528.52 and 464.66 kgha$^{-1}$ grain and 1769.43 and 1533.52 kgha$^{-1}$ straw yield and tillage with wooden plough ($T_1$) recorded 498.83 and 411.75 kg ha$^{-1}$ grain and 1680.66 and 1384.31 kgha$^{-1}$ straw yield, respectively in both the years of study. The effect of pulverization was also found significant and positive to increase the yield of safflower and rotavation treatments ($P_2$) proved its superiority (540.66 and 477.66 kg ha$^{-1}$ grain and 1848.40 and 1611.50 kg ha$^{-1}$ straw yield) over harrowing treatments. Deep ploughing resulted in significant increase in grain and straw yield, respectively over shallow tillage. This was attributed to proliferation of roots to a greater depth and consequently, a greater accumulation of above ground dry matter. Deeper and dense rooting helps to extract more water and nutrients from the soil and consequently, the higher yields (Arora *et al.*, 1991). Application of organic amendments increased grain and straw yield significantly. Among these amendments PMC ($A_2$) recorded highest 586.16 and522.83 kgha$^{-1}$ grain and 1986.52 and 1764.81 kgha$^{-1}$ straw yield followed by FYM ($A_3$) which recorded 534.41 and 467.25 kg ha$^{-1}$ and 1849.16 and 1563.27 kg ha$^{-1}$ straw yield over control in both the years study and among the seeding methods, direct seeding ($S_2$) of safflower increased 546.00 and 480.83 kg ha$^{-1}$ grain and 1867.95 and 1613.72 kg ha$^{-1}$ straw yield over two harrowing after harvest of sorghum ($S_1$) in both the years of study. This might be due to incorporation of organic amendments which create better condition by improving physical condition, increased mineralization and availability of nutrients by minimizing soil temperature and volume of soil cracks which can account profound root growth and increased yield of safflower. The results are in agreement with Reddy (1997).

***Nutrient uptake :***

The uptake of nutrients by safflower (Table 2) increased due to residual effect deep ploughing, organic amendments and direct seeding methods of safflower. The values of nutrient uptake were highest in treatments receiving tractor ploughing ($T_3$), PMC ($A_2$), pulverization by rotavation ($P_2$) and direct seeding of safflower ($S_2$). The amount of total N, P and K uptake in $T_3$ treatments were 60.63,11.12 and 51.07 and 54.62,10.92 and 47.02 kgha$^{-1}$, respectively, in both the years of study. The total N, P and K in $A_2$ treatment were 61.29,11.23 and 51.86 and 54.08,10.82 and 46.29 kg ha$^{-1}$, respectively, in both the years. The total uptake of N, P and K in $P_2$ treatment was 56.55,10.05 and 47.30 and 49.95,9.47 and 41.79 kg ha$^{-1}$, respectively in both the years. The amount of total N, P and K uptake in $S_2$ treatments were 56.55,10.03 and 47.72 and 49.68,9.39 and 42.11 kgha$^{-1}$, respectively in

**Table 1 : Yield of safflower as affected by tillage, organics and seeding**

| Treatments | Grain yield (kg ha$^{-1}$) | | | Straw yield (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|
| | 1998-99 | 1999-2000 | Pooled | 1998-99 | 1999-2000 | Pooled |
| $T_1$ | 498.83 | 411.75 | 455.30 | 1680.66 | 1384.31 | 1526.23 |
| $T_2$ | 528.52 | 464.66 | 496.66 | 1769.43 | 1533.52 | 1651.39 |
| $T_3$ | 571.16 | 523.41 | 547.29 | 1974.06 | 1789.91 | 1878.81 |
| S.E.± | 3.34 | 3.33 | 2.39 | 3.02 | 3.90 | 3.04 |
| C.D. (P=0.05) | 7.49 | 7.46 | 5.35 | 6.78 | 8.73 | 8.81 |
| $P_1$ | 525.01 | 455.55 | 490.28 | 1767.70 | 1527.00 | 1647.27 |
| $P_2$ | 540.66 | 477.66 | 509.22 | 1848.40 | 1611.50 | 1723.89 |
| S.E.± | 2.73 | 2.72 | 1.95 | 2.47 | 3.18 | 2.48 |
| C.D. (P=0.05) | 6.11 | 6.09 | 4.37 | 5.53 | 7.13 | 5.56 |
| $A_1$ | 477.93 | 409.75 | 443.91 | 1588.47 | 1379.66 | 1484.03 |
| $A_2$ | 586.16 | 522.83 | 554.50 | 1986.52 | 1764.81 | 1866.58 |
| $A_3$ | 534.41 | 467.25 | 500.84 | 1849.16 | 1563.27 | 1706.12 |
| S.E.± | 3.34 | 3.33 | 2.39 | 3.02 | 3.90 | 3.04 |
| C.D. (P=0.05) | 7.49 | 7.46 | 5.35 | 6.78 | 8.73 | 6.81 |
| $S_1$ | 518.68 | 452.38 | 486.09 | 1748.15 | 1524.77 | 1632.45 |
| $S_2$ | 546.00 | 480.83 | 513.41 | 1867.95 | 1613.72 | 1738.70 |
| S.E.± | 2.73 | 2.72 | 1.95 | 2.47 | 3.18 | 2.48 |
| C.D. (P=0.05) | 6.11 | 6.06 | 4.37 | 5.53 | 7.13 | 5.56 |

**Table 2 : Total N, P and K uptake (kg ha$^{-1}$) of safflower as influenced by tillage, organics and seeding method**

| Treatments | 1998-99 | | | 1999-2000 | | |
|---|---|---|---|---|---|---|
| | Total N uptake | Total P uptake | Total K uptake | Total N uptake | Total P uptake | Total K uptake |
| $T_1$ | 50.55 | 7.94 | 41.60 | 42.25 | 7.09 | 35.19 |
| $T_2$ | 53.80 | 9.25 | 45.39 | 48.00 | 8.80 | 14.19 |
| $T_3$ | 60.63 | 11.12 | 51.07 | 54.62 | 10.92 | 47.02 |
| S.E.± | 8.54 | 0.09 | 0.21 | 0.42 | 0.07 | 0.39 |
| C.D. (P=0.05) | 19.12 | 0.20 | 0.48 | 0.96 | 0.16 | 0.88 |
| $P_1$ | 53.23 | 8.83 | 44.74 | 46.65 | 8.41 | 39.57 |
| $P_2$ | 56.55 | 10.05 | 47.30 | 49.95 | 9.47 | 41.89 |
| S.E.± | 6.97 | 0.07 | 0.17 | 0.35 | 0.05 | 0.32 |
| C.D. (P=0.05) | 15.61 | 0.17 | 0.39 | 0.78 | 0.13 | 0.72 |
| $A_1$ | 48.01 | 7.45 | 39.76 | 42.19 | 7.14 | 35.06 |
| $A_2$ | 61.29 | 11.23 | 51.86 | 54.08 | 10.82 | 46.29 |
| $A_3$ | 55.48 | 9.63 | 46.44 | 48.63 | 8.85 | 40.69 |
| S.E.± | 8.54 | 0.09 | 0.21 | 0.42 | 0.07 | 0.39 |
| C.D. (P=0.05) | 19.12 | 0.20 | 0.48 | 0.96 | 0.16 | 0.88 |
| $S_1$ | 53.04 | 8.84 | 44.32 | 46.92 | 8.53 | 39.25 |
| $S_2$ | 56.55 | 10.03 | 47.72 | 49.68 | 9.39 | 42.11 |
| S.E.± | 6.97 | 0.07 | 0.17 | 0.35 | 0.05 | 0.32 |
| C.D. (P=0.05) | 15.61 | 0.17 | 0.39 | 0.78 | 0.13 | 0.72 |

both the years of study. Adding PMC attributed this or FYM with tillage increased availability of nutrients in a better soil physical condition with sufficient moisture throughout growing period of crops. Increased uptake of nutrient by the crops as a result of organic material with recommended doses of fertilizers and tillage was also reported by Ghonsikar and Chalvade (1986).

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