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***Research Paper***

# SOIL FERTILITY AS INFLUENCED BY RESIDUAL EFFECT OF DRY MATTER OF KAWACHBEEJ

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**Abstract**

A field experiment was conducted at Akola to study the residual effect of nutrient management along with drymatter of kawach beej on soil fertility under kawach beej-onion sequence in Inceptisol during 2011-12 and 2012-13. The experiment was laid out in RBD and comprised of nine treatments with three replication involving 2.5 and 5 t FYM $ha^{-1}$, 1 and 2 t sheep manure $ha^{-1}$, 2 and 4 t vermicompost $ha^{-1}$, 25:50 and 12.5: 25 kg NP $ha^{-1}$ through inorganic applied to *kharif* kawach beej and no any application of fertilizer to onion during *rabi* season. The significantly highest organic carbon (6.58 g $kg^{-1}$), available N (191.67 kg $ha^{-1}$), P (20.31 kg $ha^{-1}$), K (372.07 kg $ha^{-1}$) and S (8.23 mg $kg^{-1}$) were recorded with 4 t vermicompost $ha^{-1}$ followed by 5 t FYM $ha^{-1}$, 25:50 kg NP $ha^{-1}$ through inorganic and 2 t sheep manure $ha^{-1}$ applied to *kharif* kawach beej. The maximum availability of micronutrients viz., Fe (4.96 mg $kg^{-1}$), Mn (2.90 mg $kg^{-1}$), Zn (0.65 mg $kg^{-1}$) and Cu (2.31 mg $kg^{-1}$) was noticed under 4 t vermicompost $ha^{-1}$ applied to kawach beej without any application of fertilizer to onion as compared to all other treatments during both the years. The results above clearly revealed that nutrient management using kawach beej residue incorporation not only improved the soil properties like pH, EC and organic carbon but also improved the soil fertility. The crop residue recycling with kawach beej was found beneficial for organic carbon in soil as well as for addition of considerable quantity of nutrients thus enhancing soil fertility.

Key words: Kawach beej, onion, macronutrient, micronutrient, crop residue, carbon sequestration.

## INTRODUCTION

Recommended management practices to increase SOC in annual crops systems in horticulture sector (vegetables, ornamental crops, medicinal and aromatic crops) include increasing cropping frequency and growing high-residue crops. Alternatively, soil C losses can be minimized by reducing soil tillage, maximizing plant water use efficiency (more efficient rotations and improved irrigation management), and application of surface mulches that shade the soil. Incorporation of legumes can be especially effective in allocating a higher percentage of plant biomass C to belowground soil C sequestration, extending the growing season, better utilization of soil water, and reducing tillage disturbance compared to annual crops. Improved practices on croplands can increase SOC sequestration rates to 0.1 to 1 Mg C $ha^{-1}$ $yr^{-1}$, with accumulation rates diminishing as soils approach new equilibria. The vegetable biomass such as plant parts left after the harvest of the economic produce may be converted into biochars and incorporated into the soil so that the carbon may be retained for long time in the soil (Ganeshamurthy, 2011).

Crop residues can be converted into high- value manure of better quality than FYM and can be used along with chemical fertilizers. Efficient crop residue management plays a vital role in replenishing soil fertility as well as increasing the efficiency of inorganic fertilizers. It has many positive effects on soil physical, chemical and biological properties. Kawach beej is high biomass producing crop which contains large amount of macro and micro nutrients which can be added to the soil before growing of succeeding crop for maintaining soil fertility.

At present no information is available on management of this cover crop under agroclimatic condition of Vidarbha region. One of the key lessons learned is that soil management techniques like cover cropping should have multiple benefits to be acceptable to farmers. It is helpful if one or more of these benefits are highly visible. Conclusions about future viability of mucuna cover cropping indicated that positive returns are achieved at both farmers and regional levels in the second year after adopting mucuna. Mucuna crop improves the degraded soil and also reduce weed infestation. Therefore, the present study was carried out to study the residual effect of nutrient management along with crop residue of kawach beej on soil fertility under kawach beej-onion sequence.

## MATERIALS AND METHODS

The field experiments were conducted during 2011 and 2012 for kawach beej- onion sequence at Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra). The soil at the experimental site was Inceptisol with low available nitrogen (163.78 kg $ha^{-1}$), medium in available phosphorus (18.92 kg $ha^{-1}$) and high in available potassium (365.03 kg $ha^{-1}$) and low in available sulphur (7.95 mg $kg^{-1}$). The soil micronutrient content were above critical level such as Fe (4.84 mg $kg^{-1}$), Mn(2.85 mg $kg^{-1}$), Zn(0.62 mg $kg^{-1}$) and Cu (2.29 mg $kg^{-1}$). The experiment was laid out in randomized block design with nine treatments and three replications comprised of 2.5 FYM $ha^{-1}$ ($T_1$), 5t FYM $ha^{-1}$($T_2$), 1t sheep manure $ha^{-1}$($T_3$), and 2t sheep manure $ha^{-1}$($T_4$), 2 vermicompost $ha^{-1}$ ($T_5$), 4t vermicompost $ha^{-1}$($T_6$), 25:50 kg $ha^{-1}$ NP through inorganic ($T_7$) and 12.5: 25 kg $ha^{-1}$ NP through inorganic ($T_8$) and control ($T_9$). These nutritional management treatments were applied to *kharif* kawach beej crop. The kawach beej seeds (local variety) were sown during monsoon seasons of 2011 and 2012 at the spacing of 60cm X 45 cm. After harvesting the pod of kawach beej, vegetative portion of this were cut close to their bases 10-12 cm above ground level. The yield of crop residue of kawach beej was recorded treatment wise and the dried crop residue (biomass) was incorporated in the soil in the respective treatment plots along with nutrients applied to *kharif* kawach beej and their effect was studied on soil fertility after succeeding onion crop. The onion seedlings were transplanted in these plots during rabi 2011-12 and 2012-13 with the spacing of 10 cm x10cm and Akola safed variety was used.

Plot wise surface (0-15 cm) soil samples were collected after harvest of onion and processed soil samples were analyzed for determination of physico-chemical properties of soil by adopting standard procedure. Soil pH was measured in 1:2.5 soil-water suspensions and available nitrogen by Kjeldahls method (Jackson 1973). Soil organic carbon was estimated in the samples by wet oxidation method as described by Nelson and Sommers (1996). Available nitrogen by alkaline permanganate method using microprocessor based automatic distillation system (Subbiah and Asija, 1956) and available P was measured by Olsens method (Watanabe and Olsen, 1965) and available K was determined by ammonium acetate method using atomic absorption spectrophotometer and available sulphur was determined by Morgan's reagent (Chesnin and Yein, 1951). The DTPA- extractable micronutrient cations were estimated on atomic absorption spectrophotometer (Lindsay and Norvell, 1978). Thus, the data obtained on various parameters for two years were statistically analysed for test of significance (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

The data (Table 1) reveals the potential of kawach beej for nutrient addition to the soil through added biomass. Considerable quantity of nutrients has been added to the soil through the significant amount of crop residue of kawach beej.

Table 1. Chemical composition of crop residue of kawach beej added to soil

| Treatments | Kawach beej crop Residue (q ha $^{-1}$) | C:N ratio | Nutrient availability through crop residue (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|
| | | | N | P | K |
| $T_1$ - 2.5 t FYM ha$^{-1}$ | 38.89 | 13.83 | 61.67 (1.59) | 10.57 (0.27) | 46.03 (1.18) |
| $T_2$ - 5 t FYM ha$^{-1}$ | 45.10 | 13.41 | 74.04 (1.64) | 13.28 (0.29) | 55.25 (1.22) |
| $T_3$ - 1 t sheep manure ha$^{-1}$ | 38.04 | 14.10 | 59.40 (1.56) | 9.95 (0.26) | 42.91 (1.13) |
| $T_4$ - 2 t sheep manure ha$^{-1}$ | 43.56 | 13.58 | 70.54 (1.62) | 12.64 (0.29) | 54.43 (1.25) |
| $T_5$ - 2 t vermicompost ha$^{-1}$ | 40.10 | 13.83 | 63.76 (1.59) | 10.76 (0.27) | 49.59 (1.24) |
| $T_6$ - 4 t vermicompost ha$^{-1}$ | 46.68 | 13.33 | 76.93 (1.65) | 14.39 (0.31) | 59.53 (1.28) |
| $T_7$ - 25: 50 kg NP ha$^{-1}$ | 44.43 | 13.49 | 72.20 (1.63) | 13.04 (0.29) | 55.54 (1.25) |
| $T_8$ - 12.5: 25 kg NP ha$^{-1}$ | 38.01 | 14.76 | 56.51 (1.49) | 9.63 (0.25) | 44.22 (1.16) |
| $T_9$ - Absolute control | 23.41 | 15.49 | 33.18 (1.42) | 5.17 (0.22) | 25.53 (1.09) |

Values in parentheses indicate the nutrient content in per cent in crop residue

The data presented in respect of residual effect of different organics and inorganics applied to kawach beej with incorporation of crop residue of kawach beej significantly influenced the organic carbon, available macronutrient (N, P, K and S) and micronutrient (Fe, Mn, Zn and Cu).

**Soil reaction (pH) and Electrical Conductivity (EC)**

The data presented in table 2 indicated that pH and EC of soil was not statistically improved with different treatments of nutrient management but slight reduction was in pH and EC observed under 4 t vermicompost ha$^{-1}$ and also 5 t FYM ha$^{-1}$. This might be due to release of organic acids during decomposition of organic amendments and crop residues resulting in decline of soil pH and EC of soil (Srikanth *et al.*, 2000).

**Organic carbon**

The organic carbon content was significantly highest (Table 1) with the application of 4 t vermicompost. However, it was at par with 5t FYM ha$^{-1}$, 2t sheep manure ha$^{-1}$and 25: 50 kg NP ha$^{-1}$ through inorganic which was applied to *kharif* kawach beej crop during both years of experiment. This might be due to residual effect of incorporated biomass of kawach beej. The biomass such as plant parts left after the harvest of the crop retain the carbon for long time in the soil (Ganeshamurthy, 2011). The soil organic carbon was substantially enhanced at the end of two years after growing four crops in a sequence indicating considerable potential of kawach beej for addition of biomass and carbon sequestration in soil.

**Available nutrients**

The data showed significant variation in all treatments over control (Table 2). The significantly highest available N, P, K and S in the soil was observed with application of 4t vermicompost ha$^{-1}$ followed by treatment 25:50 kg NP ha$^{-1}$ through inorganic and 5 t FYM ha$^{-1}$). It was observed that the gain of nitrogen was noted after harvest of kawachbeej crop in all treatments in both the year except 12.5:25 kg NP ha$^{-1}$ and control. This may be due to inclusion of organic manure which contains appreciable amount of nitrogen and may be attributed to inclusion of kawachbeej as legume crop in sequence and also use of biofertilizer, which resulted in building up or maintenance of N availability as observed by Bairathi *et al.* (1974). The increase in available phosphorus and sulphur might be attributed to the effect of mineralization of organic sources or through solubilization of the nutrient from the native sources during the process of decomposition. These results are in conformity with findings of Bharambe *et al.* (1999), Vasanthi and Kumarswamy (1999), Naguib (2011) and Pratibha et al. (2011).The increase in availability of potassium can be attributed to effect of organic matter added through vermicompost, sheep manure or FYM which reduces the K fixation and releases K in soil solution. Considerable increased in soil available potassium with the use of organic sources has been reported by Nehra and Hooda (2002), Sonune *et* *al.* (2003) and Ravankar *et al*. (2004). The significant contents of nitrogen and potassium in kawach beej crop residue indicate the significance of this cover crop towards nutritional source as an alternative.

**Available micronutrients**

The data presented in table 3 indicated that the application of 4t vermicompost $ha^{-1}$ recorded significantly highest available micronutrient and it was found at par with treatment 5 t FYM $ha^{-1}$and 2t $ha^{-1}$ sheep manure. The possible reason for increased availability of micronutrients under these treatments might be due to addition of organic sources which enhanced microbial activity in the soil and consequent release of complex organic substances which acts as (chelating agents), which could have prevented micronutrient precipitation, fixation, oxidation and leaching. The results are conformity with findings of Bellaki *et al.* (1998) and Guled *et al.* (2002). Sharma *et al.* (2000) found that incorporation of crop residue significantly increased the DTPA extractable micronutrient i.e. Zn over their status in non residue incorporated plots. The results suggest that the crop residue recycling with kawach beej is useful for maintaining micro nutrient status of soils above their critical level.

It can thus be concluded that use of kawach beej in a crop sequence is useful for enhancing soil carbon status and improvement of soil nutrients through its considerable biomass addition to soil besides acting as a cover crop enhancing soil quality.

**Table 2. Residual effect of nutrient management of *kharif* kawach beej on soil fertility after harvest of onion**

| Treatments | pH | | EC (dS $m^{-1}$) | | Org. carbon (g $kg^{-1}$) | | Available N (kg $ha^{-1}$) | | Available P (kg $ha^{-1}$) | | Available K (kg $ha^{-1}$) | | Available S (mg $kg^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | 2013 | 2012 | 2013 | 2012 | 2013 | 2012 | 2013 | 2012 | 2013 | 2012 | 2013 | 2012 | 2013 |
| $T_1$ - 2.5 t FYM $ha^{-1}$ | 8.16 | 8.16 | 0.25 | 0.25 | 6.31 | 6.33 | 179.17 | 181.95 | 19.24 | 19.54 | 370.33 | 371.73 | 8.19 | 8.22 |
| $T_2$ - 5 t FYM $ha^{-1}$ | 8.15 | 8.13 | 0.24 | 0.24 | 6.55 | 6.58 | 185.08 | 188.06 | 19.78 | 19.96 | 371.20 | 378.26 | 8.22 | 8.23 |
| $T_3$ - 1 t sheep manure $ha^{-1}$ | 8.16 | 8.16 | 0.25 | 0.25 | 6.30 | 6.32 | 180.87 | 181.54 | 19.34 | 19.48 | 369.76 | 372.46 | 8.15 | 8.18 |
| $T_4$ - 2 t sheep manure $ha^{-1}$ | 8.15 | 8.13 | 0.24 | 0.23 | 6.50 | 6.52 | 185.11 | 186.78 | 20.20 | 20.43 | 370.28 | 376.30 | 8.21 | 8.24 |
| $T_5$ - 2 t vermicompost $ha^{-1}$ | 8.15 | 8.14 | 0.25 | 0.25 | 6.31 | 6.35 | 182.45 | 184.78 | 19.50 | 19.79 | 371.75 | 374.42 | 8.18 | 8.23 |
| $T_6$ - 4 t vermicompost $ha^{-1}$ | 8.14 | 8.13 | 0.24 | 0.23 | 6.58 | 6.61 | 191.67 | 194.00 | 20.31 | 20.47 | 372.07 | 380.73 | 8.23 | 8.25 |
| $T_7$ - 25: 50 kg NP $ha^{-1}$ | 8.14 | 8.14 | 0.24 | 0.24 | 6.56 | 6.57 | 189.63 | 193.38 | 19.64 | 20.08 | 371.69 | 377.34 | 8.22 | 8.21 |
| $T_8$ - 12.5: 25 kg NP $ha^{-1}$ | 8.18 | 8.19 | 0.25 | 0.25 | 6.13 | 6.10 | 165.31 | 162.35 | 18.65 | 19.04 | 367.56 | 366.90 | 8.13 | 8.11 |
| $T_9$ - Absolute control | 8.19 | 8.21 | 0.26 | 0.26 | 6.09 | 6.02 | 157.16 | 153.27 | 17.85 | 17.32 | 362.42 | 358.48 | 7.89 | 7.85 |
| SE (m) ± | 0.02 | 0.02 | 0.02 | 0.01 | 0.05 | 0.05 | 2.46 | 2.47 | 0.33 | 0.37 | 1.72 | 2.04 | 0.07 | 0.06 |
| CD P=0.05 | - | - | - | - | 0.14 | 0.16 | 7.36 | 7.40 | 1.01 | 1.13 | 5.16 | 6.12 | 0.20 | 0.19 |

**Table 3. Residual effect of nutrient management of *kharif* kawach beej on available micronutrient (mg $kg^{-1}$) after harvest of onion**

| Treatments | Fe | | Mn | | Zn | | Cu | |
|---|---|---|---|---|---|---|---|---|
| | 2012 | 2013 | 2012 | 2013 | 2012 | 2013 | 2012 | 2013 |
| $T_1$ - 2.5 t FYM $ha^{-1}$ | 4.88 | 4.89 | 2.81 | 2.83 | 0.64 | 0.65 | 2.30 | 2.30 |
| $T_2$ - 5 t FYM $ha^{-1}$ | 4.91 | 4.92 | 2.90 | 2.91 | 0.65 | 0.66 | 2.31 | 2.32 |
| $T_3$ - 1 t sheep manure $ha^{-1}$ | 4.86 | 4.89 | 2.80 | 2.81 | 0.64 | 0.64 | 2.30 | 2.30 |
| $T_4$ - 2 t sheep manure $ha^{-1}$ | 4.90 | 4.95 | 2.88 | 2.89 | 0.64 | 0.65 | 2.31 | 2.32 |
| $T_5$ - 2 t vermicompost $ha^{-1}$ | 4.86 | 4.90 | 2.88 | 2.89 | 0.64 | 0.65 | 2.30 | 2.30 |
| $T_6$ - 4 t vermicompost $ha^{-1}$ | 4.94 | 4.98 | 2.90 | 2.94 | 0.65 | 0.66 | 2.31 | 2.33 |
| $T_7$ - 25: 50 kg NP $ha^{-1}$ | 4.92 | 4.96 | 2.89 | 2.92 | 0.65 | 0.65 | 2.30 | 2.31 |
| $T_8$ - 12.5: 25 kg NP $ha^{-1}$ | 4.84 | 4.80 | 2.83 | 2.81 | 0.63 | 0.62 | 2.24 | 2.21 |
| $T_9$ - Absolute control | 4.49 | 4.44 | 2.80 | 2.78 | 0.62 | 0.60 | 2.23 | 2.20 |
| SE (m) ± | 0.08 | 0.07 | 0.02 | 0.02 | 0.002 | 0.004 | 0.02 | 0.02 |
| CD P=0.05 | 0.25 | 0.21 | NS | 0.06 | 0.008 | 0.013 | NS | 0.06 |

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