Energetic and Economics of Different Tillage Methods and Conservation Farming in Finger Millet

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ABSTRACT

Investigation was conducted during kharif season of 2016 at Instructional cum Research Farm, S.G. College of Agriculture and research station, Jagdalpur (C.G.). The soil of experimental field was sandy clay loam in texture and available N was low and, P and K were medium. The experiment was laid out in split plot design with two factors namely tillage practices and different conservation farming with three replications. The treatment consisted of three tillage practices viz. T1- Conventional tillage, T2 - Minimum tillage and T3 - Summer ploughing and five conservation farming viz. C1-Opening conservation, C2- Intercropping with redgram, C3- Mulching, C4- Herbicide application, C5- Combination of all treatments (C1+C2+C3+C4). Two crops were taken as a taste crop viz. finger millet cv "GPU 28" and redgram cv "Rajeevlochan". The result revealed that tillage methods produce summer ploughing recorded significantly highest gross income, net return, B: C ratio, energy output, energy use efficiency and energy productivity during experimentation. In case of conservation farming, combination of all treatments recorded significantly higher gross income and herbicide application recorded significantly higher net return and B: C ratio among all conservation farming. Energy use efficiency, energy output input ratio, energy intensiveness and energy production were recorded significantly higher in treatment herbicide application and mulching.

Introduction

Finger millet (Eleusine coracana (L.) Gaertn) is a major food crop of the semi-arid tropics of Asia and Africa and has been an indispensable component of dryland farming systems (Kerr, 2014). Dida et al., (2008) reported that the crop was domesticated in the highlands of Ethiopia and Uganda 5000 years ago, but reached India 3000 years ago. Today, the crop is ranked fourth globally in importance among the millets, after sorghum, pearl millet, and foxtail millet (Gupta et al., 2012). In India, finger millet is primarily grown in the states of Karnataka, Andhra Pradesh, Odisha, and Tamil Nadu (Dass et al., 2013). Millets are important food for sustaining tribal population in Bastar region of Chhattisgarh. The important small cereals among tribes of Bastar region after rice, kodo millet (Paspalum scrobiculatum L.) and finger millet [Eleusine coracana (L.) Gaertn.] (Verma and Mishra, 2010). The role of tillage in conserving soil moisture and its subsequent beneficial effect on crop productivity has long been recognized Adequate tillage operations controlled weeds and resulted in higher crop productivity, but caused more soil loss and
were more capital intensive (Dogra et al., 2002). The use of conservation tillage can play an important role in reducing soil erosion and improving soil quality (Uri et al., 1999) and can be an attractive to conventional tillage for farmers because of its potential to minimum labour and fuel consumption and to lower total production cost (Uri, 2000).

**Materials and Methods**

**Location of the experiment**

The field experiment was carried out during kharif session of 2016 at Instructional cum Research Farm, S.G. College of Agriculture and research station, Jagdalpur (C.G.). Bastar (Chhattisgarh) is situated in between 19°05’36.55” North latitude and 81°57’34.69” East longitude with altitude ranging from 550-760m above mean sea level. The experiment in Kharif season was framed in split plot design with three replications. The main plot treatment consisted of three tillage practices viz. conventional tillage (T1), Minimum tillage (T2) and Summer ploughing (T3) and five Conservation farming viz. opening conservation furrow (C1), Intercropping of finger millet + Red gram (C2), Mulching with crop residues (C3), Weedicide application (Pre emergence): Isoproturon @ 0.5 kg a.i. ha⁻¹ (C4) and C1+C2+C3+C4 (C5). Net returns were obtained by deducting cost of cultivation from gross returns. The benefit: cost ratio of each treatment was calculated by dividing net returns by cost of cultivation of respective treatments. Energy inputs were calculated and estimated in Mega Joule (MJ) ha⁻¹ with reference to the standard values prescribed by Mittal et al., (1985). These inputs were taken to each treatment of crops. Energy values, which were taken for energy estimation. The standard energy coefficient for seed and straw of crops was multiplied with their respective yields and summed up to obtain the total energy output. The energy input for crops was calculated by adding the respective values of input under these crops. An energy study was done by following formula:

\[
\text{Energy output (10}^{-3} \times \text{MJ ha}^{-1}) = \text{Total biological yield (Seed + straw) x Equivalent energy MJ kg}^{-1}
\]

**Results and Discussion**

**Economics**

**Gross income (Rs ha⁻¹), Net return (Rs ha⁻¹) and B: C ratio**

The response of various treatments under finger millet on economics parameter i.e. gross income, net return and benefit cost ratio are presented in Table 1. The data shows that tillage and conservation farming were recorded significantly effect. Treatment T₃ (Summer ploughing) recorded significantly higher net return and B: C ratio which was on par with treatment T₂ (Minimum tillage). Whereas, in case of conservation farming, treatment C₅ (C₁+C₂+C₃+C₄) recorded significantly higher gross income and treatment C₄ (Herbicide application) recorded significantly higher Net return and B: C ratio among all the treatment, but it was at par with C₅ (C₁+C₂+C₃+C₄) and C₄ (Herbicide application) in net return. Bali et al., (2006) observed that the application of herbicides...
proved most profitable with net returns and benefit: cost ratio. Redgram yield was recorded numerically higher in treatment T3 (Summer ploughing) in different methods, whereas, in case of conservation farming system, treatment T5 (C1+C2+C3+C4) recorded significantly higher redgram yield among all the treatments. System productivity recorded significant higher in treatment T3 (Summer ploughing) followed by treatment T2 (Minimum tillage) and in conservation farming system, treatment T5 (C1+C2+C3+C4) recorded significantly highest system productivity during the experimentation.

Energetics

Energy output, energy use efficiency, energy output input ratio, energy intensiveness and energy productivity have calculated and presented in Table 2. Energy output, energy use efficiency, energy productivity recorded significantly highest in treatment T3 (Summer ploughing) but energy output, treatment T2 was at par with T3. In conservation farming, energy output recorded significantly highest in treatment C5 among all the treatments.

Energy use efficiency, energy output input ratio, energy intensiveness and energy production were recorded significantly higher in treatment C4 and C3 and it was at par with C5 in energy intensiveness. Borin et al., (1997) noted that the energy use efficiency value increased as the number of soil tillage reduced. In order to compare the tillage methods, the fuel consumption per area was used as a measure for calculating the effectiveness of each method (Yalcin and Cakir, 2006).

Table 1 Economics, Redgram yield and system productivity of finger millet as influenced by different tillage and conservation farming

| Treatment | Gross income (Rs ha⁻¹) | Net Income (Rs ha⁻¹) | B:C Ratio | Redgram yield (q ha⁻¹) | System productivity (q ha⁻¹) |
|-----------|------------------------|----------------------|-----------|------------------------|-------------------------------|
| **Tillage Methods**                                             |                       |                       |                       |                                     |                               |
| T1        | 56655                  | 35950                | 1.76      | 1.43                   | 25.54                         |
| T2        | 47087                  | 39634                | 2.11      | 1.62                   | 27.70                         |
| T3        | 61927                  | 42386                | 2.19      | 2.18                   | 29.06                         |
| SEm±      | 782                    | 783                  | 0.04      | -                      | 0.47                          |
| CD at 0.05 | 3154                  | 3155                | 0.16      | -                      | 1.90                          |
| **Conservation farming**                                       |                       |                       |                       |                                     |                               |
| C1        | 54292                  | 33414                | 1.60      | -                      | 22.91                         |
| C2        | 49555                  | 32318                | 1.88      | 4.33                   | 26.91                         |
| C3        | 59757                  | 41000                | 2.19      | -                      | 25.39                         |
| C4        | 62994                  | 45187                | 2.55      | -                      | 27.56                         |
| C5        | 68831                  | 44697                | 1.86      | 4.37                   | 34.40                         |
| SEm±      | 1444                   | 1445                 | 0.07      | -                      | 0.72                          |
| CD at 0.05 | 4241                  | 4241                | 0.22      | -                      | 2.12                          |

T1: Conventional tillage, T2: Minimum tillage, T3: Summer ploughing, C1: Open conservation, C2: Intercropping (finger millet + redgram), C3: Mulching, C4: Herbicide application, C5: C1+C2+C3+C4
Table 2: Energy variables as influenced by different tillage and conservation farming

| Treatment | Energy output (MJ ha\(^{-1}\)) | Energy use efficiency (qMJ\(^{-1}\) x 10\(^{-3}\)) | Energy output/input ratio | Energy productivity (g MJ ha\(^{-1}\)) | Energy intensiveness (MJ Re\(^{-1}\)) |
|-----------|---------------------------------|-----------------------------------------------|--------------------------|--------------------------------------|----------------------------------|
| **Tillage Methods** | | | | | |
| T1        | 35436                           | 64.50                                         | 2.38                     | 161.84                               | 6.09                             |
| T2        | 38345                           | 80.01                                         | 3.40                     | 231.06                               | 6.29                             |
| T3        | 39523                           | 99.23                                         | 3.89                     | 264.35                               | 6.80                             |
| \(SEm\pm\) | 653                             | 1.29                                          | 0.04                     | 3.26                                 | 0.11                             |
| \(CD\ at\ 5\%\) | 2632                           | 5.21                                          | 0.24                     | 13.14                                | 0.42                             |
| **Conservation farming** | | | | | |
| C1        | 50520                           | 87.23                                         | 4.73                     | 322.02                               | 8.77                             |
| C2        | 49780                           | 68.18                                         | 4.71                     | 320.42                               | 8.33                             |
| C3        | 55979                           | 74.83                                         | 4.12                     | 280.23                               | 10.63                            |
| C4        | 60769                           | 96.67                                         | 5.83                     | 396.48                               | 11.18                            |
| C5        | 66213                           | 79.32                                         | 4.76                     | 323.98                               | 9.06                             |
| \(SEm\pm\) | 1094                          | 2.66                                          | 0.10                     | 6.08                                 | 0.20                             |
| \(CD\ at\ 5\%\) | 3211                          | 7.80                                          | 0.31                     | 17.84                                | 0.59                             |

\(T1:\) Conventional tillage, \(T2:\) Minimum tillage, \(T3:\) Summer ploughing, \(C1:\) Open conservation, \(C2:\) Intercropping (finger millet + redgram), \(C3:\) Mulching, \(C4:\) Herbicide application, \(C5:\) C1+C2+C3+C4
On the basis of one year experimentation on finger millet crop at Bastar Plateau Zone of Chhattisgarh, summer ploughing recorded significantly highest gross income, Net return and B: C ratio. Energy output, energy use efficiency, energy productivity recorded significantly highest in summer ploughing. In Conservation farming, combination of all treatment recorded significantly higher gross income and herbicide application recorded significantly higher Net return and B: C ratio among all the treatment.

Energy use efficiency, energy output input ratio, energy intensiveness and energy production were recorded significantly higher in treatment herbicide application and mulching.

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