



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; SP-9(5): 299-303
Received: 14-02-2026
Accepted: 18-03-2026

Dr. Monika Vijay Kamble
Assistant Professor of Agronomy,
Yashwantrao Chavan Government
College of Agriculture, Karad,
Satara, Maharashtra, India

Comparative economics of different input combinations in zero tillage cowpea

Monika Vijay Kamble

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i5Sd.5576>

Abstract

The field experiment, “Integrated Crop Management in Zero Tilled Cowpea under Konkan Conditions”, was performed during rabi season of 2016-17 at Agronomy Farm, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra. The experiment was conducted to examine the influence of integrated crop management strategies on economics and productivity of cowpea under zero tillage circumstances utilizing residual soil moisture following kharif rice harvest. The experiment was put up in Randomized Block Design with three replications of cowpea variety Konkan Sadabahar at a spacing of 30 × 15 cm. Eight treatments with varied combinations of weed control, recommended dosage of fertilizers, biofertilizers, multinutrient solution, plant protection chemicals, plant growth regulator and irrigation were examined under zero tillage condition. Zero tillage cultivation was found useful for timely planting and efficient exploitation of residual soil moisture in Konkan area. The results showed that the integrated crop management strategies had great effect on the economics of cowpea production. Among all the treatments, treatment T₈ including weed control, prescribed dosage of fertilizers, biofertilizers, multinutrient solution, plant protection measures, spray of paclobutrazol at 50 ppm and one irrigation at the stage of pod filling registered the greatest economic returns. Maximum cost of cultivation was seen in treatment T₈ (Rs. 27,369.52 ha⁻¹) due to incorporation of all management components. Minimum cost of cultivation was reported in absolute control treatment T₁. However, the more investments in integrated management methods resulted in far larger gross and net monetary returns. The maximum gross monetary return of Rs. 49,104.00 ha⁻¹ was observed during treatment T₈ followed by treatment T₇. Similarly greatest net monetary return of Rs. 21,621.25 ha⁻¹ was achieved under treatment T₈ suggesting the viability of integrated management methods under zero tillage condition. The absolute control treatment had the lowest gross and net returns because of poor crop growth and decreased productivity. The benefit cost ratio also varied widely across therapies. The greatest B: C ratio of 1.79 was seen in treatment T₈ which indicated improved economic efficiency and profitability over other treatments. Higher returns under integrated treatments can be due to better weed control, balanced nutrient availability, better nodulation, better pest management, effective translocation of assimilates and enough moisture availability throughout important growth phases. The research also indicated that combined use of fertilizers, biofertilizers, micronutrients and plant growth regulators boosted the development and production of crop by activating the physiological and biochemical processes of the plant system. Effective weed control decreased the crop-weed competition during early development stages and extra irrigation provided at pod filling stage helped in improved seed filling and yield production. The results underscored the necessity of integration of several agronomic methods for optimum production and profitability of cowpea under conservation agriculture systems.

Keywords: Zero tillage, cowpea, integrated crop management, residual moisture, biofertilizers, multinutrient solution, paclobutrazol, weed management, economics, benefit-cost ratio, Konkan conditions, conservation agriculture

Introduction

Zero tillage has become a key component of conservation agriculture and sustainable crop production systems notably in pulse based cropping cycles. Zero tillage is a crop planting method where crops are sown directly into the untilled soil with minimal disturbance of soil and maintaining crop leftovers on soil surface. The system has been paid much attention in recent decades for its role in decreasing production costs, preserving soil moisture, limiting soil erosion and enhancing soil health. Zero tillage is particularly useful in pulse crops like cowpea under

Corresponding Author:
Dr. Monika Vijay Kamble
Assistant Professor of Agronomy,
Yashwantrao Chavan Government
College of Agriculture, Karad,
Satara, Maharashtra, India

rice fallow conditions and helps in optimal use of residual soil moisture for crop establishment and development. This approach helps in saving fuel and labour apart from early planting which is very important for improved yields under residual moisture conditions. Studies in Indo-Gangetic plains have demonstrated that zero tillage leads to considerable reduction in greenhouse gas emissions, conservation of fossil fuel energy and improvement in water use efficiency (Hobbs *et al.*, 2008) ^[5]. Moreover, crop residues retention under zero tillage stimulates microbial activity, soil organic carbon content and nutrient cycling within the soil system. These elements together generate a conducive environment for root growth and biological nitrogen fixing in pulse crops. Zero tillage settings have demonstrated good outcomes in cowpea cultivation in terms of growth and production. The crop has various beneficial agronomic properties like quick germination, early vigour, spreading growth habit and drought tolerance making it extremely ideal for conservation agriculture systems. Cowpea has an ability to use leftover soil moisture efficiently due to its deep root structure and efficient water withdrawal ability. Cowpea is frequently planted in Konkan in Maharashtra after the rice harvest utilizing the leftover moisture in the soil profile. Such a type of farming helps the farmers to get extra revenue from the land which normally remains fallow during the rabi season (Kadrekhar, 1990) ^[6]. Weed infestation is one of the important restrictions in restricting the yield of cowpea under conventional as well as zero tillage methods. Weeds compete fiercely with agricultural plants for nutrients, moisture, sunshine and space and reduce crop growth and output. Pulse crops are especially vulnerable to weed competition during early crop growth because pulses often have modest early growth and poor canopy formation. Weeds are also hosts for insects, pests and disease organisms and are thus responsible for agricultural losses. Hence, effective weed control is very important for improved production and better resource use efficiency in cowpea culture. The best sustainable technique to weed control is integrated weed management, which includes cultural, mechanical and chemical treatments. Weed control is even more important in zero tillage systems since disturbance to the soil is reduced which leads to changes in weed flora and weed emergence patterns (Singh *et al.*, 2010) ^[12]. Nutrient management is also very important to improve the yield and quality of cowpea. Pulses may fix atmospheric nitrogen, but still need balanced diet for maximum growth and development. Continuous cropping, uneven fertilizer usage and degradation of soil fertility have made the deficiency of key nutrients, especially micro nutrients, a common concern in intensive agricultural systems. Micronutrients, such as zinc (Zn), boron (B), molybdenum (Mo), copper (Cu), iron (Fe) and manganese (Mn), are needed in very minute amounts yet play very important physiological and biochemical roles in plants. These nutrients are involved in the synthesis of chlorophyll, activation of enzymes, photosynthesis, synthesis of proteins, metabolism of carbohydrates, production of pollen and processes of nodulation. Deficiency of micronutrient negatively affects plant growth, blooming, pod development, seed production and finally reduces the yield and quality (Alloway, 2008) ^[11].

Plant growth regulators (PGRs) have also acquired relevance in contemporary agriculture since they may control the physiological processes and increase the crop production. Plant growth regulators are organic substances other than nutrients, which affect plant growth and development at low concentrations. These chemicals aid in changing plant architecture, increasing photosynthesis, source-sink interaction and reduction in flower and fruit drop. Low yield in cowpea is

generally linked to excessive vegetative growth and inadequate transfer of assimilates. Plant growth regulators such as cycocel, naphthalene acetic acid (NAA), gibberellic acid (GA3) and salicylic acid have been reported to be effective in improving flowering, pod formation and seed yield by maintaining hormonal balance within the plant system (Pandey, 1975; Nickell, 1978) ^[9, 8].

Material and Methodology

The Present investigation was carried under Konkan condition at Agronomy farm, College of Agriculture, Dapoli, Dist Ratnagiri (M.S.) during rabi hot weather season of the year 2016-17. The analytical work was done in research laboratory of the Department of Agronomy.

The field experiment was performed at the Agronomy Farm, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.) on plot 22 of 'A' block during rabi season 2016. Rabi cowpea was grown soon after kharif rice harvest using zero-tillage techniques. Precipitation in this subtropical region averages 3500 mm per year, falling from June to October in 95 to 100 days. The meteorological observatory at Agronomy farm, College of Agriculture, Dapoli collected weather data from 46th MW of 2016 to 7th MW of 2017 (the trial phase). In 2016-17, morning and afternoon RH ranged from 88 to 91.3 percent and 38 to 67.9 percent, respectively. The bright sunshine hours in 2016-17 varied from 6.9 (46th MW) to 9.3 (04th MW). The experimental plot has lateritic soil from mixed parent material. These soils include mostly kaolinite and some illite. Flat terrain makes the experimental field excellent for rabi cowpea growing. By screw auger, composite soil samples were obtained from 30 m deep before the experiment to examine physical and chemical parameters. The recovered soil was dried and stored in aluminum bins. Its physico-chemical characteristics were then examined. The experiment was conducted on cowpea (variety Konkan Sadabahar) using a spacing of 30 × 15 cm. A Randomized Block Design was adopted with three replications to ensure accuracy. Each treatment was applied within a gross plot size of 6.0 m × 4.5 m under uniform agronomic conditions.

Treatments Table 1

T₁: Absolute control	—
T₂: T ₁ + Weed control	(2 Hand weeding)
T₃: T ₂ + RDF	(25:60:40)
T₄: T ₃ + Bio-fertilizers	(Rhizobium and PSB)
T₅: T ₄ + Multinutrient solution	(content- N, P, K, S, Zn, Cu, B, Mo)
T₆: T ₅ + Plant protection	(Cypermethrin, Phosphamidon)
T₇: T ₆ + Paclobutrazol	(50 ppm spray)
T₈: T ₇ + One Irrigation	(Pod filling stage)

Cost of Cultivation

The whole amount of money spent on cultivating a cowpea crop, beginning with the preparation of the land and ending with the harvest, is referred to as the cost of cultivation. The expenses associated with harvesting, intercultural activities and the expenditures of seed, fertilizers, irrigation, labor, equipment and plant protection agents are included in there. The economic feasibility and profitability of various therapies or procedures may be evaluated with the assistance of this metric.

Gross Returns

The whole revenue received from the cowpea crop is referred to as gross monetary returns and it is calculated without taking into

account any production expenditures. For the purpose of calculating it, the total product yield is multiplied by the current market price of cowpea grain and fodder. It is possible to determine the earning potential and productivity performance of the experimental treatments by referring to this metric.

Net Returns

After deducting the complete cost of cultivation from the gross monetary returns, the real profit that is achieved is referred to as the net monetary returns. When it comes to cowpea cultivation, it represents the economic benefit that a treatment or management method will bring about. Net returns that are higher suggest that the treatment is more suitable for farmers, that it is more profitable and that it makes better use of the resources available.

Benefit: Cost Ratio (B:C Ratio)

The benefit of the cost ratio is that it is an economic measure that compares the overall cost of cultivation to the gross monetary returns, or financial returns. In order to determine it, divide the total gross profits by the total cultivation cost. When the B:C ratio is higher, it suggests that the cowpea production method or treatment under experimental circumstances is more economically efficient and profitable.

Statistical tool

Analysis of variance was used to analyze experimental data in randomized block design. Panse and Sukhatme (1967) tested the significance of the treatment difference using a variance ratio test (f value), critical difference (C.D.) at 5% probability and treatment means for statistical interpretation.

Result in present investigation

Cost of cultivation

Based on the information provided in Table 2, the overall cost of cowpea cultivation may be inferred. With a mean value cost of

Rs. 18222.78 per hectare, it can be deduced from Table 2 that the cultivation cost was substantially higher under treatment T₈ (Rs. 27369.52 per hectare), followed by treatment T₇ (24958 per hectare). Similar to the previous treatment, treatment T₆ recorded the highest cost of cultivation compared to treatments T₅, T₄, T₃, T₂ and T₁ in that sequence of decreasing expense. Nevertheless, the treatment T₁ was the one that had the lowest cost of cultivation since it was the absolute control treatment.

Gross returns

The information that was provided in Table 2 showed that the average gross return from cowpea that had not been tilled was Rs. 28726.58 per hectare. Upon closer inspection of Table 2, it becomes apparent that the treatment T₈ achieved considerably higher gross returns (Rs. 49104.00 ha⁻¹) than the other treatments. This was followed by the treatment T₇, which likewise achieved better results compared to the other treatments in the decreasing order of importance. On the other hand, treatment T₁ had the lowest net return (Rs.8704ha⁻¹) of all the treatments.

Net returns

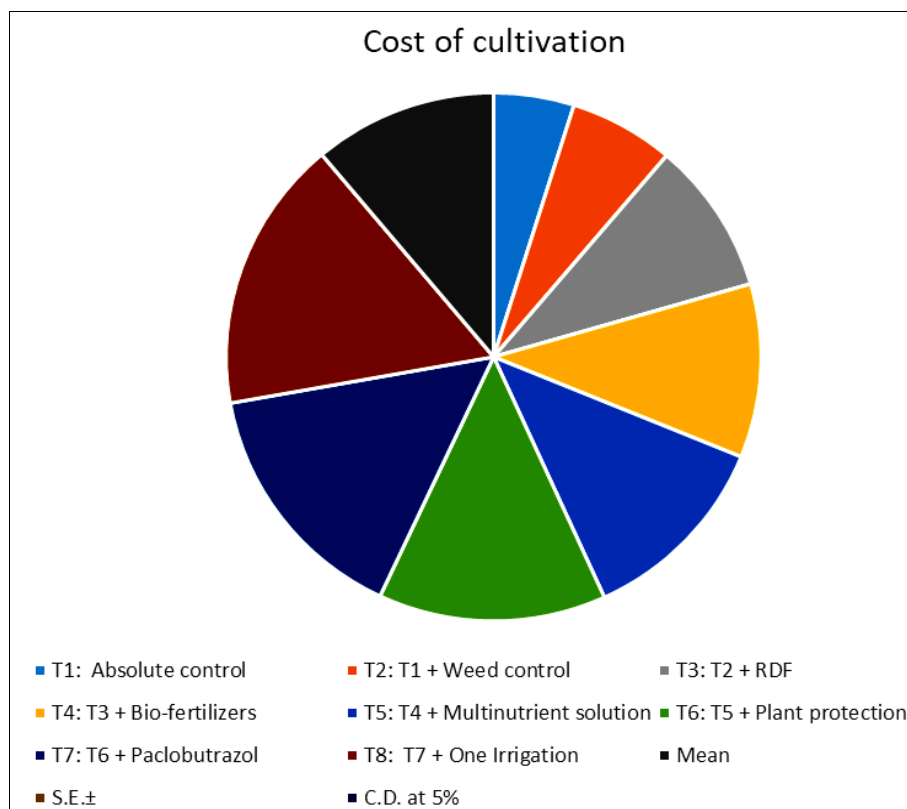
Data presented in Table 2 revealed that the mean net returns of cowpea were Rs. 10462.03 ha⁻¹. Net return was found significantly maximum with the treatment T₈ (Rs. 21621.25 ha⁻¹) which was profitable followed by treatments viz., T₆, T₇, T₅, T₄, T₃ and T₂. However the lowest Net return was found in treatment T₁ (Rs. 509 ha⁻¹).

B:C ratio

The benefit-to-cost ratio of various therapies was observed, as shown by the data given in Table 2. In terms of the B:C ratio, the mean value was 1.53. Following treatment T₂ (1.66), the B:C ratio was found to be considerably highest with treatment T₈ (1.79), which was followed by treatment T₂.

Table 2: Cost of cultivation, gross return, net return and B:C ratio of cowpea as influenced by different treatments

Treatments	Cost of cultivation (Rs.ha-1)	Gross return (Rs. ha-1)	Net return (Rs. ha-1)	B:C ratio
T ₁ : Absolute control	7979	8704	509	1.09
T ₂ : T ₁ + Weed control	10394	17290	6897	1.66
T ₃ : T ₂ + RDF	15317	24224	8907	1.58
T ₄ : T ₃ + Bio-fertilizers	17441	26490	9050	1.51
T ₅ : T ₄ + Multinutrient solution	19723	30000	10276	1.52
T ₆ : T ₅ + Plant protection	22601	36700	14099	1.62
T ₇ : T ₆ + Paclobutrazol	24958	37300	12343	1.49
T ₈ : T ₇ + One Irrigation	27370	49104	21621	1.79
Mean	18222.78	28726.58	10462.03	1.525
S.E.±	—	0.248	76.59	—
C.D. at 5%	—	0.752	232.31	—



Conclusion

The current research revealed that integrated crop management strategies such as weed control, suggested fertilizer application, biofertilizers, multinutrient supplementation, plant protection, plant growth regulators and irrigation management may enhance the Konkan zero-till cowpea farming. Different agronomic treatments under zero tillage condition resulted in considerable improvement in financial performance and productivity of cowpea production at Agronomy Farm, College of Agriculture, Dapoli during 2016-17 rabi season. According to the study, conserving agricultural methods not only keep crop yields at the same level but also lower production costs and conserve soil resources. Zero tillage cowpea cultivation after rice harvest using residual soil moisture proved successful and resource efficient. Weed control improved crop vigor and output via nutrients, moisture, light and space. Weed management is one of the most significant agronomic treatments in pulse farming, especially in conservation agriculture systems where there is minimal soil disturbance and weed emergence patterns vary. The recommended fertilizer dose in treatment T₃ supplied the macro nutrients essential for vegetative development, flowering and pod formation thereby increasing the crop productivity. This indicated that cowpea cultivation required balanced macro-micronutrient management to improve productivity and profitability. The treatment T₆ significantly decreased the insect pests and diseases and saved the crop from losses in output. Reduced insect infestation ensured healthy crop development leading to higher biomass yield and economic returns. In experiment T₇, paclobutrazol modulated vegetative growth and enhanced assimilate partitioning to reproductive organs leading to higher crop yield. The growth regulator likely regulated plant hormones to improve flowering, pod set and seed development. Yield and economic returns were due to physiological improvements. One irrigation during pod filling (T₈) integrated crop management had the highest economic returns and benefit cost ratio. Additional irrigation during pod filling supplied the soil moisture needed for photosynthesis and seed development.

The treatment recorded the highest gross, net and B:C ratio. This indicates that targeted irrigation under residual moisture conditions enhances crop output and profitability. The superiority of T₈ proved that zero-tillage cowpea cultivation with fertilizer management, weed control, plant protection, growth regulation and supplemental watering is highly productive and economically possible. Economic analysis indicated that inclusion of management components raised cultivation costs but the associated increase in gross and net returns compensated for the expense. Treatment T₈ had the greatest gross monetary returns and net profits but the highest cultivation cost owing to all the management strategies. The better benefit-cost ratio of T₈ made the package commercially feasible and advantageous to farmers. The lowest returns and profitability was in the absolute control treatment, which emphasizes the need of scientific crop management practices for better yield. The statistical analysis of the randomized block design showed the treatment differences to be large and reliable. Therefore, the experimental findings are in favor of integrated management practices for Konkan zero-tilled cowpea agriculture. The research found that conservation agriculture, balanced nutrient management, weed management, biofertilizers, micronutrient application, plant protection, growth regulators and supplementary irrigation may enhance crop yield and farm profitability. The research proved the possibility of growing cowpea under zero-tillage after rice harvest under residual moisture conditions. Integrated crop management and specifically treatment T₈ increased economic returns, efficiency in use of resources and production. Such technology may help farmers to make optimal use of rice fallow fields, reduce production costs, conserve natural resources and improve farm profitability. Zero tillage integrated management might be a suitable production technology for sustainable cowpea production in Konkan and other agro-ecological areas.

References

1. Ali M, Kumar S. Advances in pulses research in India. Indian Society of Pulses Research and Development; 2005.

2. Alloway BJ. Zinc in soils and crop nutrition. International Zinc Association; 2008.
3. Choudhary AK, *et al.* Growth and productivity of pulses under different management systems. Indian Journal of Agronomy. 2011;56(3):234-240.
4. Fageria NK, Barbosa Filho MP, Moreira A. Foliar fertilization of crop plants. Journal of Plant Nutrition. 2009;32:1044-1064.
5. Hobbs PR, Sayre K, Gupta R. The role of conservation agriculture in sustainable agriculture. Philosophical Transactions of the Royal Society B. 2008;363:543-555.
6. Kadrekar SB. Studies on pulse cultivation in Konkan rice fallows. Konkan Krishi Vidyapeeth Research Bulletin; 1990.
7. Lal R, *et al.* Role of legumes in soil carbon sequestration and sustainable agriculture. Agronomy Journal. 2017;109:1-15.
8. Nickell LG. Plant growth regulators in agriculture and horticulture. Horticultural Reviews. 1978;1:253-282.
9. Pandey SN. Effect of growth regulators on yield and physiology of pulse crops. Indian Farming. 1975;25(7):15-18.
10. Patagundi MS, *et al.* Micronutrient management in pulses. Karnataka Journal of Agricultural Sciences. 1997;10(2):345-348.
11. Singh BB, *et al.* Cowpea genetic resources and breeding. Plant Breeding Reviews. 2003;23:215-274.
12. Singh VP, *et al.* Weed management in conservation agriculture systems. Indian Journal of Weed Science. 2010;42(1-2):1-12.
13. Timko MP, Singh BB. Cowpea, a multifunctional legume. In: Genomics of Tropical Crop Plants. New York: Springer; 2008. p. 227-258.
14. Vikhe PA, *et al.* Water management studies in pulse crops under dryland conditions. Journal of Maharashtra Agricultural Universities. 1983;8(2):145-148.