

Original Research Article

<https://doi.org/10.20546/ijcmas.2019.806.107>

Effect of Tillage and Cultural Practices on Growth, Yield and Economics of Kodo Millet

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A B S T R A C T

Keywords

Tillage, Cultural practices, Kodo millet

Article Info

Accepted:

10 May 2019

Available Online:

10 June 2019

A field experiment was carried out during rainy season of 2016 at the Instructional Farm, JNKVV College of Agriculture, Rewa (M.P.) “To study the effect of tillage and cultural practices on growth, yield and economics of kodo millet”. Kodo millet crop when grown by adopting conservation tillage practices and sowing of pigeonpea as intercrop followed by opening of conservation furrow between paired rows of pigeonpea (C_2) resulted in better growth and development of kodo millet over rest of the tillage and cultural practices. Conservation tillage (T_2) was found the most suitable tillage practice for growing kodo millet crop under skeletal soil. The net return as well as benefit: cost ratio was reckoned highest from the treatment (T_2C_2) here intercropping of kodo millet + pigeonpea was done followed by opening in the ratio of 2:4 conservation furrows between paired rows of pigeonpea due to the higher price of pigeonpea over the kodo millet. Whereas, the farmers obtaining for sole kodo millet should grow kodo millet by adopting conservation tillage and application of crop residue as mulch for obtaining higher benefit.

Introduction

Kodo millet is grown on marginal lands with poor management practices; therefore, intercropping with pigeonpea is recommended (Anonymous, 2008). It is getting more attention today due to increasing incidence of less seasonal rainfall, terminal heat, frequent occurrence of extreme weather event coupled with scanty water resources

(Singh *et al.*, 2010). When these crops are intercropped with pigeonpea are benefitted to be advantages as these crops are able to use the growth resources differently and make better use of growth resources than grown in sole cropping. Pigeonpea is a late maturing, tall growing, wide spaced crop with deep root system and can be accommodated with rapidly growing, short duration and statured crops like kodo millets.

The conservation tillage system impact soil moisture status because it influences infiltration, runoff, evaporation and soil water storage. Conservation tillage system is a method in which at least 30% of soil surface remains covered by crop residues. Conservation tillage as compared to conventional tillage improves soil and water resources, save energy and time, and reduces the cost of Agricultural production. As compared to conventional tillage, minimum tillage protects the soil from wind and water erosion, favours microbial growth; improved soil structure, increased infiltration rate, soil respiration, dehydrogenase activity in upper layer, soil organic carbon and soil microbial biomass is significantly congenial in minimum tillage as compared to conventional tillage (Singh *et al.*, 2007). Research work on

improved tillage practices coupled with intercropping of kodo millet with pigeonpea has not been done in Rewa region of Madhya Pradesh. Therefore, the present research was taken up.

Materials and Methods

The field experiment was carried out during the rainy season 2016 at the Instructional Farm, JNKVV College of Agriculture, Rewa (M.P.). The soil of the experimental field was sandy having pH 7.7, electrical conductivity 0.5 dS/m, organic carbon 0.53%, available N, P₂O₅ and K₂O 225, 12.52 and 443 kg/ha, respectively. The treatments were 2 tillage practices in main plots and 6 cultural practices in the sub-plots.

T₁	Conventional tillage: 4 ploughing + secondary tillage for seed bed preparation (farmers practice)
T₂	Conservation tillage/minimum tillage: 2 ploughings + secondary tillage.
C₁	Opening conservation furrow after every 6 rows.
C₂	Intercropping of <i>kodo</i> millet + red gram and opening conservation furrows between paired rows of pigeonpea.
C₃	Mulching with crop residues.
C₄	Weedicide application (pre emergent: Isoproturon @ 0.5kg a.i./ha).
C₅	Sole <i>kodo</i> millet crop.
C₆	C ₁ + C ₃ + C ₄ + C ₅ .

An uniform basal dose of 20 kg nitrogen and 20 kg phosphorus/ha was applied through urea and DAP and 20 kg nitrogen/ha was applied as top dressing through urea in all treatments.

The kodo millet variety "RK 390-25" was sown on 20th July 2016 @ 11 kg seed/ha and pigeonpea variety ICPH-87119 was sown on 20th July 2016 keeping row to row spacing 30 cm and 60 cm, and plant to plant 10 cm and 45 cm in kodo millet and pigeonpea, respectively. The kodo millet was harvested on 23rd September 2016 and pigeonpea was

harvested on 28th February, 2017. The total rains received from June 2016 to February, 2017 were 1502 mm.

Results and Discussion

Growth parameters

The chief characters of number of leaves/plant, and dry matter accumulation govern the growing habits of a crop. Both tillage and the cultural practices had a significant effect upon growth characters. Kodo millet crop sown by adopting

conservation tillage practices gave better expression of growth characters. *Viz.*, number of leaves/plant, and dry matter production. It might be due to the fact that conventional tillage practices resulted in losses of soil water and nutrient in field and degraded the soil to low organic matter content and a fragile physical structure, which in turn led to low crop yields. Similar finding has been reported by Wang *et al.*, (2007) and Lal, (2002) Intercropping of kodo mill *et al.*, along with red gram and opening of conservation furrow resulted in highest mean number of leaves per plant. Enhanced number of leaves/plant contributed to increased plant fresh weight and finally to the dry matter production reported the similar finding and postulated that under cooler soil condition plant can grow vigorously contributing to increased plant biomass. Salhin *et al.*, 2013, Palaniappan and Sivaraman, (1994) and Subbareddy and Venkateshwarlu, (1992) were of same opinion.

Yield attributing characters

The final outcome of crop is yield which is directly governed by various yield attributing characters. As per the present finding the yield attributing characters *viz.*, number of panicle/meter row length, length of panicle (cm), number of grains/panicle, weight of grains/panicle and test weight (g) were significantly influenced by the tillage and cultural practices. The above stated yield attributes were found maximum under conservational tillage practices. Sowing of kodo millet under intercropping system along with opening of conservation furrow proved superior and resulted in higher value for all the yield attributing characters. The most possible explanation for better yield attributes under these cultural practices may be that the beneficial effect of nitrogen fixation by legume supported the better expression of yield attributes. The variation in yield

attributing characters in kodo millet and other small millets have also been reported by many research workers (Singh and Arya, 1994; Anonymous, 2000-2001; Patil *et al.*, 2010).

Grain and straw yield

The results from the present experiment clearly indicate that tillage and the cultural practices had a significant effect on grain and straw yield the highest grain yield to the tune of 15.16 q/ha was obtained under conservation tillage which was 5.06% higher over the conventional tillage practices. Among cultural practices intercropping of kodo millet + pigeonpea in 4:2 row proportion and opening conservation furrows between paired rows of pigeonpea (C₂) resulted in highest grain yield of 17.51 q/ha which was 54.86% higher over the lowest yielding treatment C₅. This might be due to the fact that mulching resulted in conservation of soil moisture and also prevented the loss of nutrient from soil and resulted in better expression of yield attributes and yield. This finding supports the work of Yadav *et al.*, 2007. Thus, it is possible to assess the productivity of any cropping system with the productivity of only an individual crop component. Therefore combined yields of all components grown under a particular cropping sequence was determined as kodo millet equivalent yield on the basis of prevailing market price of the produce for an individual crop component under a particular cropping system play an important role on the *kodo* millet equivalent yield.

The kodo millet equivalent yield has been given in Table 1 reveals that kodo millet + red gram gave 22.01 q/ha kodo millet grain equivalent yield which was significantly superior over all the cultural practices. This finding support the work of Singh *et al.*, (2009), Kumar *et al.*, (2009), Patil *et al.*, (2010).

Table.1 Growth, yield-attributes, yield and economics of kodo millet as influenced by tillage and cultural practices

Treatments	Plant height (cm)	Tillers /m row length	Leaves/plant	Dry matter/plant (g)	Panicles /m row length	Panicle length (cm)	Grains/panicle	Grains weight/panicle (g)	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Net income (Rs/ha)	B:C ratio
Tillage practices														
T₁	65.66	83.58	19.79	1.82	81.57	26.8	147	1.22	4.05	14.43	43.66	24.81	21516	1.76
T₂	67.46	87.11	20.79	1.93	86.05	27.3	155	1.26	4.12	15.16	45.04	25.30	25061	1.91
C.D.(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.22	NS	--	--
Dates of sowing														
C₁	63.44	68.33	19.67	1.57	80.90	25.7	146	1.21	4.01	14.00	42.53	24.87	18634	1.68
C₂	71.33	98.59	23.37	2.48	96.88	29.4	174	1.37	4.21	17.51	53.17	24.78	42967	2.52
C₃	70.83	91.66	21.50	2.32	88.60	27.8	159	1.29	4.12	15.83	47.67	24.96	24853	1.91
C₄	65.83	88.09	21.26	1.78	87.59	28.0	158	1.28	4.08	15.18	44.00	25.65	22429	1.89
C₅	63.49	64.68	15.30	1.28	63.63	24.2	115	1.04	3.98	11.32	37.05	23.64	10900	1.41
C₆	65.44	85.73	20.65	1.83	85.26	27.2	153	1.25	4.08	14.94	41.67	26.41	19948	1.69
C.D.(P=0.05)	7.45	15.17	1.10	0.35	4.74	1.69	8.4	0.05	NS	0.83	2.94	NS	--	--
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	Sig.	NS	--	--

Likewise straw yield was also found to be higher under conservation tillage practices. Whereas, among the cultural practices mulching with crop residues (C_3) resulting higher straw and opening conservation furrow after every 6th rows along with $C_1 + C_4 + C_5$ (C_6) resulted in lower straw yield while the maximum straw yield was recorded under intercropping system with opening of furrows (C_2).

Economics

The final outcome of crop production is represented in terms of monetary returns being obtained from the crop. Economics of the different treatment is directly related to the success of that particular treatment and the extra input and output due to that treatment. The highest net income was Rs.42967/ha in case of (C_2) intercropping of kodo millet + red gram and opening conservation furrows between paired rows of pigeonpea and the lowest net income was Rs.10900/ha in case of C_5 . The calculation of benefit: cost ratio is another way of expressing the economics of the treatments. It is based on the income as against the total expenditure incurred on that particular treatment. In the present study, the B:C ratio of each treatment was obtained exactly in accordance with the net income received from that treatment. Accordingly treatment C_2 registered the highest B:C ratio upto 2.52 and the lowest B:C ratio (1.41) was obtained in case of C_5 treatment. The C_3 treatment stood the second best in the economical grain because of lowest input cost, check weed growth and conserve soil moisture etc.

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How to cite this article:

Kumer Singh Malviya, L. Bakoriya, S. Kumar, S. Aske, G. Mahajan and Malviya, K.D. 2019. Effect of Tillage and Cultural Practices on Growth, Yield and Economics of Kodo Millet. *Int.J.Curr.Microbiol.App.Sci*. 8(06): 890-895. doi: <https://doi.org/10.20546/ijcmas.2019.806.107>