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Zero Tillage Technology in Jute Cultivation: A Successful Venture in West Bengal

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A B S T R A C T

Farmers' participatory demonstrations on jute cultivation using zero tillage (ZT) technology were conducted in West Bengal through standardized conservation agriculture (CA)-jute protocols developed jointly by Uttar Banga Krishi Viswavidyalaya and International Maize and Wheat Improvement Centre (CIMMYT). The results of demonstration indicated a significant yield increase under ZT over conventional practices.On an average, an yield increase of 25.83-27.83% under zero tillage technology reflected the positive effect of demonstration over the existing practices. It was attributed to maintenance of higher plant population with increased plant height and basal diameter under ZT. There was a considerable saving in total man-days requirement (41-42 man-days over one hectare) for the crop due to herbicidal management of weeds. The higher returns with reduced cost of cultivation under ZT technology helped to register a higher profit in terms of B:C ratio (3.36 -4.19) over CT practices (1.99 - 2.59).The successive decreased value of technology index (20.52 – 17.10 %) reflected the feasibility of the technology. It can be concluded that ZT technology can be considered as a successful technology in jute in terms of productivity as well as profitability for further adoption of technology.

Introduction

Jute (*Chorchorus spp*) plays an important role in our country's economy, particularly in eastern and north eastern states. Jute and allied fibre farming, trading and industry provide sustenance to more than five million people of our country (Mahapatra *et al.*, 2009). West Bengal is the major jute growing state sharing about three- fourth of the total production of the country. It is the second most important commercial fibrecrop next to cotton grown mostly in humid tropical or sub-tropical climate under rainfed condition. It is predominantly cultivated by marginal and small farmers of Indo-Bangladesh subcontinent.

Jute-rice is a popular cropping system in northern part of West Bengal. Jute was initially regarded as “Golden Fibre” considering its national importance. However, the area under this crop in West Bengal is gradually declining due to various reasons and at present around 5.15 lakh ha was under cultivation with an annual production of 75.11 lakh MT (Anonymous, 2018). Though the warm humid climate with occasional rainfall during pre-monsoon season in the region is very suitable for the crop, but with ever increasing area under *rabi* maize throughout the *terai* region of West Bengal, area under jute gets lowered down each year. The negative growth in jute area in the country as a whole was reflected by Kumari *et al.*, (2018). Again, under the scenario of labour migration and less preference of agricultural work due to greater drudgery and risk involvement, the farmers are not interested to grow jute in which a lot of man-days required for weeding in a broadcasted crop as well post-harvest operation like steeping, retting and fibre extraction. Further the marketing of the fibre is substantially controlled by middleman which deprive the farmers in getting remunerative price. However, in recent years, the crop is gaining importance under the context of environment pollution and the preference of the people to use natural products instead of man-made synthetic substitutes which are non-biodegradable.

Due to low levels of mechanization, high labour requirements and costs, the overall production costs are high which results in low farm profits in various cropping systems (Gathala *et al*., 2016; Brown *et al*., 2017). It has promoted a practice which is ecologically sustainable as well as profitable. The conservation agriculture (CA) based new agronomic management practices, comprising three basic steps: minimum or no tillage, residue retention & management and judicious crop rotations, are advocating to overcome above challenges and it is serving as a viable technology through which yield can be increased sustainably with reduced cost of cultivation (Hobbs *et al*., 2008 ; Krishna *et al*., 2016). In *Gangetic* plains, most of the conservation agriculture research work was conducted on cereal crops, wheat in particular where it was demonstrated that CA-based management can enhance yields with reduced cost of cultivation (Chauhan *et al.*, 2012; Gathala *et al*., 2013; Mitra *et al*., 2019). Through conduction of a number of participatory trials in eastern Gangetic plains, Islam *et al.*, (2019) reported increased yields with improved water productivity under various rice-based systems, even in system involving jute. It was a huge challenge to sow such a small seeded crop through zero till drill, but intense effort of CIMMYT in collaboration with Uttar Banga Krishi Viswavidyalaya standardised the protocols for CA-jute under an Australian Centre for International Agriculture Research (ACIAR) funded project entitled “Sustainable and Resilient Farming System Intensification in Eastern Gangetic Plains (SRFSI)”and this protocol was tested in various farmers fields. It was probably the first attempt in India to sow jute with multi-crop planter. Attempts were also taken to sow it with happy seeder under wheat residue which was also successful. The productivity as well the production economics were thoroughly calculated to judge the feasibility of CA-jute in farmers’ field.

Materials and Methods

Farmers’ participatory demonstrations were conducted in Hawargari, Ghughumari, Barashakdal, Barsimulguri, Patakamari and Latapota villages of Coochbehar and Kalaberia Banabasti, Dakshin Kamsing and Purba Kathalbari villages of Alipurduar district of West Bengal during pre-kharif season of 2018 and 2019 (Table 1) through standardized CA-jute protocols developed by UBKV and CIMMYT. The seeding, fertilizer management and weed management of the crop were standardized through conduction of station trials. The protocol of CA-jute was described in Table-2.

The package of practices adopted in conventionally tilled (CT)-jute plots were quite different crop CA-jute. The seeds were mostly broadcasted @ 7.5 kg/ha with or without seed treatment. Fertilizer dose was kept at 60-30-30 following state government's recommendation. Weeding was totally performed manually.

Before demonstration, group meetings were conducted in each and every village where problems associated with jute cultivation were discussed and the advantages of growing jute under CA was described. A probable list of interested farmers was prepared from the meeting through intervention of the officers of Department of Agriculture, Government of West Bengal, being a partner in SRFSI project. Further, team of scientists from UBKV and government grass root level extension officials visited the land of the selected farmer in presence of the villagers. Before implementing the programme, the skill development trainings were organized involving the selected farmers.

Field days and other extension programmes were also organized inviting the farmers of the demonstrated and nearby villages. Mitra and Samajdar (2013) described the role of frontline demonstration as an effective tool for enhancing the yield of jute fibre in sub-Himalayan plains of West Bengal, India.

Data on major yield attributing character and fibre yield were collected from both demonstration and control plots. Technology gap, extension gap and technology index were worked out using the formula used by Mitra *et al.,* (2014).

The formula was cited below:
Technology gap (kg/ha) = Potential yield (kg/ha) -Demonstration yield (kg/ha)

Extension gap (kg/ha) = Demonstration yield (kg/ha) - Farmers' yield (kg/ha)

Technology Index (%) = (Potential yield - Demonstration yield) /Potential yield × 100

Results and Discussion

The results of demonstration indicated a significant yield increase under ZT over CT technology (Table 3). In both the years, the fibre yield obtained under ZT was higher (3020 and 3150 kg /ha during 2018 and 2019, respectively) with the corresponding values of 2400 and 2470 kg/ha under CT. It was also noted that the demonstration yield was higher in 2019 (3150 kg/ha) over 2018 (3020 kg/ha). It was attributed to maintenance of higher plant population with increased plant height and basal diameter (Table 4) in 2019.The plant height recorded under ZT jute was varying between 310-350 cm with basal diameter ranging between 20-25 mm, much higher than CT-jute over both the years of demonstration. Moreover, the plant population maintained in the field in the second year was quite close to 5 lakh/ha, the optimum plant population for the crop. With greater precision in calibrating the seeding machines over the years, it was possible to maintain optimum plant population in the field for which the crop performed better due to increased utilization of resources. Maintaining proper seed rate *vis-a-vis* optimum plant population was supposed to be the most crucial factor in determining the growth of jute plant and for obtaining maximum yield (Islam and Ali, 2017). On an average, the yield increase of 25.83-27.83% in ZT-jute reflected the positive effect of demonstration over the existing practices. The variation in yield attributing characters as well as yields in the successive years could also be attributed to variation in the prevailing climatic condition during the crop growth period. Successive increase in demonstration yield over the years reflects the success of the demonstration (Mitra *et al*., 2014).

In ZT technology the weeds were controlled through herbicides which curtailed the man-days requirement *vis-à-vis* cost incurred towards weeding to a great extent. Manual weeding alone contributed a high proportion of total cost of cultivation. In this region, high pre-monsoon showers coupled with high humidity results in huge weed infestation and farmers have to bear major share of expenditure for controlling weeds (Bhattacharya *et al*., 2004; Ghorai *et al*., 2004). Use of post-emergence herbicides may curtail the cost of cultivation and this practice in jute was supposed to be an economic option (Datta *et al*., 2015; Mitra *et al*., 2017). Due to herbicidal control of weeds, there was a considerable saving in total man-days requirement for the crop as a whole and it was revealed that under zero tillage there was saving of 41-42 man-days over one hectare (Table 5).

As far as production economics were concerned, the data clearly indicated the advantages of ZT technology over the conventional practices (Table 6). The higher gross and net returns with reduced cost of cultivation under ZT technology helped to register a higher profit. The B:C ratio under ZT technology was much higher(3.36 and 4.19 in 2018 and 2019, respectively) over CT practices (1.99 and 2.59 during 2018 and 2019, respectively). The higher profit in 2019 over 2018 was due to higher market price of jute fibre prevailed during 2019.

Table.1 Details of demonstration

Year	No. of Demo.	No. of farmers involved	Area (ha)	Variety used
2018	46	135	18.25	JBO 2003H
2019	85	240	28.80	JBO 2003H
Total	**131**	**375**	**47.05**	-

Table. 2 CA-jute protocols developed by UBKV and CIMMYT

Days of activities	Details of activities
6 days before seeding	Spraying of Glyphosate @ 1 kg a.i./ha
On the day of seeding	Sowing with zero-till-drill (seed rate @ 7.5 kg/ha) after mixing with dry vermicompost (60 kg/ha)
On the day of seeding	Fertilizer application through multi-crop planter @ N-P-K(10-26-26) @ 150 kg/ha; seeds to be treated with Carbendazim @ 2-3 g/kg of seeds/Trichoderma @ 5 g/kg of seeds
1-2 days after seeding	Spraying of pretilachlor @ 0.5 kg a.i./ha
15-20 days after seeding	Irrigation + first top dressing (urea @ 90 kg/ha)
20-25 days after seeding	Spraying of propaquizalofop @ 50 g a.i./ha + ethoxysulfuron @ 18 g a.i./ha
30-35 days after seeding	Irrigation + second top dressing (urea @ 60 kg/ha + MOP @ 30 kg/ha)
40-45 days after seeding	Spraying of carbendazim @0.1%

Table.3 Yield performances under demonstration

Year	Potential yield (kg/ha)	Demo.(ZT) yield (kg/ha)	Local check(CT) yield(kg/ha)	% yield increase
2018	3800	3020[a]	2400[b]	25.83
2019	3800	3150[a]	2470[b]	27.53

Within a row means followed by different letter are significantly different (p = 0.05) using T test

Table.4 Comparison between CT-Jute and ZT-Jute in relation to major yield attributing characters

Yield parameters	ZT-Jute		CT-Jute	
	2018	**2019**	**2018**	**2019**
Plant height(cm)	290-340(310)	310-350(322)	250-280(270)	270-305(285)
Basal diameter(mm)	19-23(20)	19-25(22)	15-18(16)	15-18(17)
Plant population/m^2	44-50	49-55	47-50	48-55

Figures in the parenthesis indicates average value

Table.5 Comparative man-days requirement per hectare under CT and ZT-Jute

Components	2018		2019	
	ZT	**CT**	**ZT**	**CT**
Seeding	0	2	0	2
Fertilizer application	2	3	2	3
Weeding and thinning	6	55	6	60
Harvesting	35	30	40	32
Steeping, Retting and Fibre extraction	30	25	35	25
Total	**73**	**115**	**83**	**122**

Table.6 Detailed cost of cultivation for ZT and CT-Jute

Year	ZT-Jute				CT-Jute			
	Total cost of cultivation (Rs./ha)	**Gross income* (Rs./ha)**	**Net income (Rs./ha)**	**B : C ratio**	**Total cost of cultivation (Rs./ha)**	**Gross income (Rs./ha)**	**Net income (Rs./ha)**	**B : C ratio**
2018	29205	98150	68945	3.36	39215	78000	38785	1.99
2019	31965	133875	101910	4.19	41065	104975	63910	2.56

N.B.:(*)Market price for jute fibre was Rs. 3250 and Rs. 4250 per quintal in 2018 and 2019, respectively

Table.7 Component-wise cost of cultivation for ZT and CT-Jute

Components	2018		2019	
	ZT	CT	ZT	CT
Land preparation	0	7500	0	7500
Seed	480	600	450	565
Seeding	3750\	500	3750	500
Fertilizer application	4450	3115	4740	3250
Weeding and thinning	4275	13750	4275	15000
Harvesting	8750	7500	10000	8000
Steeping, Retting and Fibre extraction	7500	6250	8750	6250
Total	**29205**	**39215**	**31965**	**41065**

Table.8 Technology gap, extension gap and technology index recorded under ZT-Jute demonstration

Year	Technology gap(kg/ha)	Extension gap(kg/ha)	Technology Index(%)
Pre-kharif 2018	780	620	20.52
Pre-kharif 2019	650	680	17.10
Mean	**715**	**650**	**18.81**

The overall saving or curtailment of cost in total cost of cultivation under ZT technology was attributed to the components 'land preparation' and 'weeding operations' (Table 7). No extra cost was incurred towards land preparation and at the same time the weeds were controlled through use of herbicides which was much cheaper than manual weeding. However, due to higher prices of complete complex fertilizers used in zero till drill, the cost involvement in fertilizer management was little bit higher under ZT technology. All together, around Rs. 9,000-10,000 per hectare could be saved under ZT technology.

The technology gap, ranging from 780-650 kg/ha with an average of 715 kg/ha, reflected the farmers' cooperation in carrying out the demonstrations with encouraging results (Table 8). The differences in technology gap may be attributed to variability in soil status and prevalent weather condition. With better execution of frontline demonstrations, it was possible to reduce the gap in subsequent years.

The extension gap increased slightly in the successive years (620 during 2018 and 680 during 2019).The increasing involvement of farmers towards adoption of this newly introduced technology is required to reverse the trend. Wider adoption of this particular technology may reduce the extension gap in future.

Technology index was recorded to be decreased over the successive years of study. The technology index was varying from 20.52 – 17.10 % with an average of 18.81 % (Table 8). The successive decreased value of technology index reflected the feasibility of the technology. The lower the values of technology index more will be the feasibility of the demonstration (Jeengar *et al*., 2006; Mitra and Samajdar, 2013; Mitra *et al*., 2014). From the study it can be concluded that ZT technology can be considered as a successful technology in jute in terms of productivity as well as profitability. Appropriate policy decisions are required for its promotion in West Bengal and its adjoining areas

References

Annonymous.2018. Annual Report of AINP on Jute and Allied Fibres-2017-18, CRIJAF, Barrackpore

Bhattacharya, S.P., Mondal, L., Pal, D. And Saha, M. 2004. Bio-efficacy of Targa super (Quizalofop ethyl 5% EC) for controlling weeds in jute. *Pestology* 28(4): 32-35.

Brown, P.R., Darbas, T., Kishore, A., Rola-Rubzen, F., Murray-Prior, R., Anwar, M., Hossain, S., Islam, R., Rashid, M., Nur-E-Alam, M., Siddquie, M., Datt, R., Kumar, U., Pradhan, K., Das, K.K., Dhar, T., Bhattacharya, P.M., Chowdhury, A.K., Ghosh, A., Sapkota, B., Thapa, D., Pokharel, D., Adhikari, S., Sugden, F., Saikia, P., de Silva, S., Maskey, N., Maharjan, S., Gathala, M. and Tiwari, T. 2017. Implications of Conservation Agriculture and Sustainable Intensification Technologies for Scaling and Policy: Synthesis of SRFSI Socio-economic Studies. CSIRO, IFPRI, Curtin University, IWMI, CIMMYT, partner organizations in EGP joint publication. ACIAR, Canberra, Australia.

Chauhan, B. S., Mahajan, G., Sardana, V., Timsina, J. and Jat, M. L. 2012. Productivity and sustainability of the rice-wheat cropping system in the indo-gangetic plains of the indian subcontinent: problems, opportunities, and strategies. *Advances in Agronomy 117*: 315–369.

Datta, M.K., Halder, P., Biswas, U. and Kundu, C.K.2017. Effect of different weed management practices on growth and yield of tossa jute (*Corchorus olitorius*) in the new alluvial zone of West Bengal, India. *International Journal of Current Microbiology and Applied Sciences* 6(11): 1118-1123.

Gathala, M. K., Kumar, V., Sharma, P. C., Saharawat, Y. S., Jat, H. S., Singh, M., *et al.*, 2013. Optimizing intensive cereal-based systems addressing current and future drivers of agricultural change in the north western Indo-Gangetic plains of India. *Agriculture, Ecosystems and Environment177*: 85–97.

Gathala, M.K., Timsina, J., Islam, M.S., Krupnik, T.J., Bose, T.R., Islam, N., Rahman, M.M., Hossain, M.I., Harun-ARRashid, Ghosh, A.K., Hasan, M.M.K., Khayer, M.A., Islam, M.Z., Tiwari, T.P. and McDonald, A.J. 2016. Productivity, profitability, and energetics: a multi- criteria and multi-location assessment of farmers' tillage and crop establishment options in intensively cultivated environments of South Asia. *Field Crops Research* 186: 32-46.

Ghorai, A.K., Chakraborty, A.K., Pandit, N.C., Monda, I.R.K. andBiswas, C.R. 2004. Grass weed control in jute by Targa super (quizalofop etthyl 5% EC). *Pestology*, 28(2): 31-34.

Hobbs, P.R., Sayre, K. and Gupta, R. 2008. The role of conservation agriculture in sustainable agriculture. *Philosophical Transactions of the Royal Society B*

363: 543-555.

Islam, M. and Ali, S. 2017.Agronomic research advances in jute crops of Bangladesh. *AASCIT Journal of Biology* 3(6): 34-46.

Krishna, V., Keil, A., Aravindakshan, S. and Meena, M. 2016. Conservation Tillage for Sustainable Wheat Intensification: the Example of South Asia. Chapter 14.BurleighDodds Science Publishing Limited, pp. 1–21.

Kumari, K., Devegowda, SR and Kushwaha, S. 2018. Trend analysis of area, production and productivity of jute in India. *The Pharma Innovation Journal* 7 (12): 58-62.

Mahapatra, B.S., Mitra, S.,Sinha, M.K. and Ghorai AK. 2009. Research and development in jute and allied fibresin India: A review. *Indian Journal of Agronomy* 54(4): 361-373.

Mitra, B. and Samajdar, T. 2013. Frontline demonstration: an effective tool for enhancing the yield of jute in sub-Himalayan plains (Terai Zone) of West Bengal. *Agricultural Science Digest*, 33*(1):38-41*.

Mitra, B., Majumdar, K., Dutta, S.K., Mondal, T., Das, S., Banerjee, H., Ray, K. and Satyanarayana, T. 2019. Nutrient management in wheat (*Triticum aestivum*) production system under conventional and zero tillage in eastern sub-Himalayan plains of India. *Indian Journal of Agricultural Sciences* 89 (5): 775-784.

Mitra, B., Mookherjee, S. and Biswas, S. 2014. Promotion of short duration rice variety Gotra- Bidhan-1 (IET 17430) through frontline demonstration in Terai region of West Bengal. *Journal of Crop and Weed* 10(1): 111-114.

Mitra, B., Samajdar, T. and Islam, M. 2017. Effect of weed control measures in jute under *Terai* zone of West Bengal, India. *Environment and Ecology* 35(1): 84-87.

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