

Original Research Article

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## Cotton Crop Management Practices Adopted in a Tribal Region of Odisha

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### ABSTRACT

The farmers in the tribal districts of Gajapati and Rayagada have been cultivating cotton as a commercial crop over the years to support their livelihood. Adoption of appropriate crop management practices helps to minimize the deleterious effects of production factors and leads to improvement in cotton yields. A study was undertaken on 240 cotton growers from four blocks of the two districts. Data was collected personally on the extent of adoption of standard crop management practices through a semi-structured schedule and analysed using appropriate statistical methods. It was observed that the respondents largely adopted the basic cotton cultivation practices recommended. However, deficiencies were observed in levelling, sub-plotting, bunding, adoption of appropriate crop cultivars, application of recommended dose of manures and fertilisers based on soil test, delimiting and treatment of seeds, sowing in paired rows, drilling two seeds per pit, 3<sup>rd</sup> weeding, hoeing and earthing-up at six weeks, hormone application, plant protection measures after 110 days of sowing, picking bolls in the cool hours of morning, picking at 50% bursting of bolls, and avoiding admixtures of leaves. Extension contact, house type, social participation, annual income, farming experience, and aptitude of the respondents significantly influenced adoption of recommended crop management practices. The agricultural extension officials promoting cotton cultivation in these districts have to analyse these factors and take appropriate measures to enrich the knowledge and skills of cotton farmers to enable them to adopt suitable crop management practices to generate more income.

#### Keywords

Cotton, Crop cultivars, Crop management, Crop yields, Extension officials

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### Introduction

Cotton occupies a predominant position in Indian economy by generating direct and indirect employment in the agricultural and industrial sectors. It provides livelihood for about 250 million people in India through

cultivation, trade, and textile industries (Rajeswar *et al.*, 2019). Sustainability of cotton production relies on achieving high yields through precise water, nutrition, and crop growth management (Cetin and Basbag, 2010). In addition, fruiting of cotton plant is determined and influenced by cultivars,

climatic conditions, and crop management practices including control of insect pests and diseases. Environmental factors such as rainfall, evaporation, humidity, sunshine duration, and surface soil temperature significantly affect flower and boll production (Sawan *et al.*, 2002). Adoption of appropriate cultural practices helps to minimize the deleterious effects of these factors and leads to improvement in cotton yields (Sawan, 2009). Therefore, cotton farmers have to adopt suitable crop management practices for sustainable crop production with reduced cost and increased yield and minimize health risks and environmental damage by reducing the use of chemical fertilizers and pesticides as well as by better use of natural resources such as water and soil nutrients (Padwal *et al.*, 2018). This study was therefore undertaken to assess the crop management practices adopted by the farmers in two cotton growing districts of Odisha.

## **Materials and Methods**

The study was undertaken in the tribal regions of Odisha, India. Two tribal dominated districts, *viz.* Gajapati and Rayagada, having cotton cultivation were selected. Rayagada and Kashinagar blocks in Gajapati district as well as Gunupur and Ramanaguda blocks in Rayagada district were randomly selected. Similarly, four panchayats in each block, *viz.* Sanatundi, Kumelsingha, Karadasingi, and Rayagada in Rayagada block, and Budura, Khandaba, Alada, and Goribandha in Kashinagar block, Gadhikhala, Sirijholi, Chalkamba, and Jaganathpur in Gunupur block as well as Buting, Nilamguda, Bhamini, and Golumunda in Ramanaguda block were randomly selected. Around 15% of the farmers cultivating cotton from all these panchayats were also selected randomly. Thus, 67 farmers from Rayagada, 53 from Kashinagar, 62 from Gunupur, and 58 from Ramanaguda blocks were selected randomly as respondents for the study with the total

sample size being 240.

The data was collected personally through a semi-structured schedule after pretesting. Data was collected from the farmers on the extent of adoption of standard crop management practices of land preparation, sowing, delinting seed treatment prior to sowing, manure and fertilizer applications, intercultural operations, plant protection, and harvest and post-harvest operations. The data was collected on the scale point of fully, partially, and not adopted on various aspects of crop management practices and were analysed with the score values of 3, 2 and 1, respectively. Statistical tools such as mean score, gap percentage, rank order, and path analysis were employed to deduce the results.

## **Results and Discussion**

A fine seed bed is essential for securing a good plant stand. Summer and deep ploughing and well pulverised soil with clean and friable seed bed are recommended in land preparation. It was observed that the respondents adopted 3 to 4 summer ploughings, deep ploughing at 15-20 cm depth, planking after each ploughing, choosing soil with good water holding capacity, good aeration with no water logging, and high in organic matter content, as well as preparing clean, friable, and well pulverized seed bed (Table-1). The findings therefore revealed that the respondents in general adopted most of the recommended practices in land preparation.

Early sowing ensures good harvest. In southern Odisha, cotton is recommended to be sown in the month of June immediately following the onset of monsoon to evade disease and insect pest attack. Analysis of data revealed that (Table-2) the respondents adopted the recommended practices of sowing in June at the onset of monsoon and sowing in

single rows. The respondents sowed hybrid seeds that were available in the market and raised additional seeds in leaf bags to be used later for gap filling to maintain optimum plant spacing. Poor adoption of recommended practices were observed while using Bunny, American, and Indian cotton varieties, sowing in double rows, sowing two seeds per pit, and sowing seeds by drilling. It is apprehended that the respondents had little knowledge about the crop varieties, advantage of sowing in double rows for better yields, sowing two seeds per pit as a safety measure against poor germination, and sowing seeds by drilling for better soil coverage.

Delinting of cotton seeds is essential for good germination. The seeds are treated with sulphuric acid followed by thorough washing. Poor adoption of seed delinting treatment practices by the respondents was observed (Table-3). Though the farmers positively responded for sowing delinted seeds and soaking in water for 10-12 hours, poor adoption of the practice of delinting was

observed while soaking seed in sulphuric acid for two minutes, washing in running water, and drying under shade before sowing.

Cotton crop responds well to nitrogenous fertiliser. Phosphorous and potassic fertilisers are also recommended. Split application and spraying of fertilisers is found to be beneficial. Soil test based fertiliser application is usually advocated for better crop growth and production. Hormone application at 45 and 60 days is essential at square and boll formation stage to check boll shedding. Spraying of 1.5% DAP at 70 and 90 days and 0.75% of both DAP and MOP at 105 days and spraying of urea 2-3 times at 10-day intervals 60 days after sowing is also recommended. But, the respondents were not following these practices indicating poor adoption. However, better adoption was observed on using recommended dose, basal application of phosphorous and potash as well as split application of nitrogenous fertiliser.

**Table.1** Adoption of practices in land preparation

Sl. No.	Practice	Mean Score		Pooled Mean Score (n=240)	Rank
		Gajapati District (n=120)	Rayagada District (n=120)		
1	3-4 summer ploughings	2.83	2.72	2.77	1
2	Deep ploughing at 15-20 cm depth	2.47	2.46	2.46	7
3	Planking after each ploughing	2.43	2.45	2.44	8
4	Good water holding capacity of soil	2.57	2.57	2.57	4
5	High organic matter content in soil	2.70	2.38	2.54	6
6	Good aeration in soil	2.48	2.43	2.46	7
7	Good surface drainage to avoid waterlogging	2.80	2.57	2.68	2
8	Preparing well pulverised soil	2.62	2.49	2.55	5
9	Maintaining clean and friable seed bed	2.69	2.55	2.62	3

Maximum obtainable score: 3

**Table.2** Adoption of practices in sowing

Sl. No.	Practice	Mean Score		Pooled Mean Score (n=240)	Rank
		Gajapati District (n=120)	Rayagada District (n=120)		
1	Using seeds of Bunny, American and Indian cotton	1.38	1.38	1.38	8
2	Hybrid variety available in the market	2.89	2.68	2.78	2
3	Sowing immediately after onset of monsoon	2.49	2.41	2.45	4
4	Sowing in single rows	2.83	2.96	2.89	1
5	Sowing in paired rows	1.23	1.13	1.18	9
6	Sowing 2 seeds per pit	1.67	1.68	1.68	7
7	Sowing by drilling seeds in rows	1.97	1.83	1.90	6
8	Spacing of 90 x 90 cm	2.77	2.76	2.76	3
9	Raising additional seeds in leaf bag for gap filling	2.43	2.33	2.38	5

Maximum obtainable score: 3

**Table.3** Adoption of practices in seed treatment

Sl. No.	Practice	Mean Score		Pooled Mean Score (n=240)	Rank
		Gajapati District (n=120)	Rayagada District (n=120)		
1	Sowing delinted seeds	2.06	2.29	2.18	1
2	Soaking seeds in water for 10-12 hours	2.03	2.15	2.09	2
3	Rubbing with fresh cow dung and wood ash after soaking	1.63	1.66	1.65	5
4	Soaking in 70-100 ml sulphuric acid for two minutes	1.31	1.55	1.43	6
5	Washing in running water after soaking	1.68	1.95	1.82	4
6	Drying under shade before sowing	1.75	1.92	1.83	3
7	Not treating the seeds	1.53	1.23	1.38	7

Maximum obtainable score: 3

**Table.4** Adoption of practices in manure and fertiliser applications

Sl. No.	Practice	Mean Score		Pooled Mean Score (n=240)	Rank
		Gajapati District (n=120)	Rayagada District (n=120)		
1	Applying 4-5 tonnes of organic manure/ ha	1.91	2.05	1.98	8
2	Applying 120-60-60 NPK/ha	2.59	2.62	2.60	3
3	All P and K applied as basal	2.74	2.72	2.73	2
4	25% N at 20 days stage	2.81	2.88	2.85	1
5	50% N at 45 days	2.60	2.29	2.45	4
6	Rest of N as 2-3 urea sprays at 10-day intervals after 60 days	2.06	2.09	2.08	6
7	Adopting soil test based fertiliser	1.30	1.48	1.39	10
8	Spraying 1.5% DAP at 70 and 90 days after sowing	2.28	2.10	2.19	5
9	Spraying 0.75% of both DAP and MOP at 105 days after sowing	1.55	1.54	1.55	9
10	Spraying hormone at 45 and 60 days to check boll shedding	1.96	2.12	2.04	7

Maximum obtainable score: 3

**Table.5** Adoption of practices in intercultural operations

Sl. No.	Practice	Mean Score		Pooled Mean Score (n=240)	Rank
		Gajapati District (n=120)	Rayagada District (n=120)		
1	Bunding, levelling, and sub-plotting	1.27	1.15	1.21	9
2	First hoeing and thinning 10-12 days after emergence	2.23	2.38	2.31	5
3	Gap filling with seeds raised in leaf bags	2.61	2.80	2.70	3
4	Second weeding and hoeing during third week	2.70	2.90	2.80	2
5	Third weeding, hoeing, and earthing-up at 6 weeks	1.83	1.57	1.70	8
6	Keeping the crop weed- free up to 30-40 days after sowing	2.33	2.23	2.28	7
7	Drainage to prevent waterlogging	2.53	2.30	2.42	4
8	Life saving irrigation during dry spell	2.38	2.23	2.30	6
9	Removing apical portion of the plant at 1m height to promote reproductive branches	2.94	2.94	2.94	1

Maximum obtainable score: 3

**Table.6** Adoption of practices in plant protection

Sl. No.	Practice	Mean Score		Pooled Mean Score (n=240)	Rank
		Gajapati District (n=120)	Rayagada District (n=120)		
1	1 <sup>st</sup> spraying of chemicals 2-3 weeks after sowing	2.85	2.97	2.91	3
2	2 <sup>nd</sup> spraying after 50-55 days	2.88	2.95	2.92	2
3	3 <sup>rd</sup> spraying after 70 days	2.93	2.97	2.95	1
4	4 <sup>th</sup> spraying after 80-95 days	2.74	2.88	2.81	4
5	5 <sup>th</sup> spraying after 110 days	2.08	2.23	2.16	5
6	Mixing both insecticides and fungicides in spraying	1.54	1.39	1.47	6

Maximum obtainable score: 3

**Table.7** Adoption of practices at harvest and post-harvest

Sl. No.	Practice	Mean Score		Pooled Mean Score (n=240)	Rank
		Gajapati District (n=120)	Rayagada District (n=120)		
1	Ensuring moisture at boll bursting	2.48	2.40	2.44	6
2	Picking when 50% bolls were bursting	2.10	2.15	2.13	9
3	Picking bolls by hand	2.72	2.76	2.74	2
4	4-5 pickings within 50 days	2.47	2.18	2.33	8
5	Picking only fully burst open bolls	2.84	2.69	2.77	1
6	Picking bolls during cool hours of morning	1.90	1.78	1.84	11
7	Avoid admixture of leaves	2.05	2.09	2.07	10
8	Spreading bolls in sun for 2-4 hours to dry	2.63	2.63	2.63	4
9	Not keeping picked cotton bolls in wet channels in the field	2.39	2.45	2.42	7
10	Uprooting plant after last picking and burying to kill insect pests and disease pathogens	2.56	2.43	2.49	5
11	Ploughing the field to incorporate debris into soil	2.68	2.63	2.66	3

Maximum obtainable score: 3

**Table.8** Path analysis of attributes influencing adoption of practices (n=240)

Sl. No.	Attribute	Total effect	Total direct effect	Total indirect effect	Substantial effect		
					I	II	III
X <sub>1</sub>	Age	0.035	0.004	0.031	0.159x <sub>6</sub>	0.137x <sub>12</sub>	-0.055x <sub>2</sub>
X <sub>2</sub>	Education	0.115	0.071	0.044	0.162x <sub>5</sub>	0.120x <sub>14</sub>	0.038x <sub>11</sub>
X <sub>3</sub>	Holding size	0.109	0.048	0.061	0.142x <sub>12</sub>	0.086x <sub>15</sub>	0.041x <sub>4</sub>
X <sub>4</sub>	Farming experience	0.064	-0.016	0.080	-0.178x <sub>6</sub>	0.113x <sub>6</sub>	-0.071x <sub>8</sub>
X <sub>5</sub>	Caste	-0.051	-0.112	0.061	-0.206x <sub>1</sub>	-0.167x <sub>9</sub>	0.088x <sub>13</sub>
X <sub>6</sub>	Social participation	0.137	0.097	0.040	-0.223x <sub>1</sub>	-0.172x <sub>8</sub>	0.074x <sub>6</sub>
X <sub>7</sub>	Cosmopolitaness	0.180	0.190	0.002	0.081x <sub>14</sub>	0.077x <sub>7</sub>	0.062x <sub>15</sub>
X <sub>8</sub>	Extension contact	0.002	-0.178	0.192	0.195x <sub>13</sub>	0.114x <sub>12</sub>	0.023x <sub>8</sub>
X <sub>9</sub>	Source of information	0.120	-0.013	0.133	-0.256x <sub>2</sub>	0.186x <sub>3</sub>	-0.042x <sub>9</sub>
X <sub>10</sub>	House type	0.171	0.170	0.001	0.165x <sub>8</sub>	0.115x <sub>4</sub>	0.058x <sub>15</sub>
X <sub>11</sub>	Occupation	-0.030	-0.046	0.016	-0.206x <sub>7</sub>	0.167x <sub>9</sub>	0.088x <sub>13</sub>
X <sub>12</sub>	Annual income	0.058	-0.005	0.063	0.223x <sub>5</sub>	0.172x <sub>8</sub>	-0.074x <sub>7</sub>
X <sub>13</sub>	Social aptitude	0.133	0.027	0.106	0.181x <sub>11</sub>	0.117x <sub>7</sub>	-0.062x <sub>6</sub>
X <sub>14</sub>	Economic aptitude	0.178	0.110	0.068	-0.256x <sub>8</sub>	0.186x <sub>13</sub>	-0.042x <sub>9</sub>
X <sub>15</sub>	Scientific orientation	0.139	-0.017	0.156	0.144x <sub>6</sub>	-0.105x <sub>4</sub>	0.042x <sub>10</sub>

Residual effect: 0.033

Highest indirect effect: Extension contact

Intercultural operations, particularly weeding, hoeing, earthing-up, drainage channelling, levelling, sub-plotting and gap filling need to be done timely. The data in Table-5 revealed better adoption of gap filling with seeds raised in leaf bags, 2<sup>nd</sup> weeding and hoeing during 3<sup>rd</sup> week, removing apical portion of the plant at 1m height to promote reproductive branches, as well as drainage to prevent water logging. Adoption of life saving irrigation during dry spell, first weeding and thinning 10-12 days after emergence, and keeping the crop weed-free up to 30-40 days after sowing was not satisfactory and needed improvement. Poor adoption was observed on bunding, levelling, and sub-plotting. In crop management practices that were adopted poorly, the farmers require a better understanding and training through educational approaches by the extension officials promoting cotton cultivation in the two districts.

Cotton crop is affected by diseases such as root rot, fusarium wilt, anthracnose, bacterial blight, leaf spot, and boll rot and by insect pests such as boll worm, jassids, aphids, thrips, white fly, and leaf roller. Integrated insect pest and disease management is recommended and farmers need to go for a minimum of five sprayings. Cotton farmers are generally very concerned about plant protection measures. This might be the reason why the respondents adopted the practices of 1<sup>st</sup> to 4<sup>th</sup> spraying as given in Table-6. The farmers need to be educated about the 5<sup>th</sup> spraying after 110 days and spraying with mixtures of both insecticides and fungicides.

Harvesting of cotton is usually done by hand picking and 4-5 pickings are suggested to complete the harvest. As observed in Table-7, adoption of practices was well done for hand picking fully burst open bolls, ploughing of field after harvest to incorporate debris into soil, spreading harvested bolls in sun for 2-4

hours to dry, uprooting cotton plant after last picking and burying to kill insect pests and disease pathogens, ensuring moisture at boll bursting, and not keeping picked cotton bolls in wet channels in the field that impairs quality. However, deficiencies were observed in picking bolls during the cool hours of morning, avoiding admixture of leaves while picking, initiating picking when 50% of bolls were bursting, as well as 4-5 pickings within 50 days to complete harvest.

Path analysis was carried out to segregate the total effect of socio-economic attributes of respondents into direct, indirect, and residual effects. It was observed that the attribute extension contact had the highest indirect effect and showed association with five other attributes (Table-8). Hence, the attribute extension contact channelised through house type, economic aptitude, social participation, annual income, and farming experience exhibited significant influence on adoption of recommended practices in cotton crop cultivation. The residual effect of 0.033 inferred that 3.3% of the variation in this association could not be explained.

In conclusion, cotton is one of the primary economic bases of the people, mostly tribals, in the study districts. The farmers have been cultivating cotton over the years for income generation to support their livelihood. They have accumulated experience because of which they could adopt recommended crop management practices fairly satisfactorily. However, poor adoption of recommended practices was observed in using crop cultivars, sowing in paired rows, drilling two seeds per pit, delinting treatment of seeds, and applying recommended organic manures and chemical fertilisers, particularly based on soil test.

Deficiencies in adoption of recommended practices were also observed in hormone

application, 3<sup>rd</sup> weeding, hoeing and earthing-up at 6 weeks, bunding, levelling and sub-plotting, plant protection measures 110 days after sowing, picking of bolls during the cool hours of morning, picking at 50% bursting of bolls, and avoiding admixture of leaves at harvest. Socio-economic attributes such as extension contact, type of dwelling, social participation, annual income, farming experience, and economic aptitude significantly influenced proper adoption of crop management practices.

Since cotton was the primary source of income generation for the respondent farmers, the agricultural extension officials promoting cotton cultivation in these districts have to analyse the factors responsible for poor adoption of certain crop management practices and take appropriate approaches to enrich the knowledge and skills of the farmers to enable them to adopt suitable crop management practices to enhance yields and generate more income.

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