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Performance of Ramie in *Jhum* fallow system of Nagaland: A new initiative

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Abstract
Ramie (*Boehmeria nivea* L.) the strongest and longest natural fibre having manifolded uses at different land use systems. In view of its wide adoptive nature a field experiment was conducted on ramie (variety-*Hazarika*) during the year of 2014-2017, to assess its potential performance and productive capacity in *jhum* fallow system of Wokha district in Nagaland. An intensive training cum demonstration programme was imparted for the selected farmers on scientific package of practices on ramie cultivation and fibre extraction methods before conducting the experiment at farmer's field. A total of 3.6 lakh number of ramie plantlet were planted in the farmer's field in a participatory mode to cover an area of 6 ha. The result of the experiment revealed that the ramie fibre crop performed better in *jhum* fallow system with yield ranged from 16.21 to 18.15 q/ha/year in four cuttings of the year. The average cost of ramie cultivation was Rs. 18,500/- per ha/year. The net annual return for ramie cultivation varied from Rs. Rs. 33,814/- to Rs.46,021/- per ha/year with B: C ratio of 3.16:1 thereby, revealing that promotion of ramie cultivation is quite feasible under the *jhum* fallow areas of Nagaland. Further, it was noticed that promotion of ramie in *jhum* fallow had also improved soil fertility status by enhancing soil pH, soil organic carbon (SOC) and available nitrogen content.

Keywords: Ramie, fibre, *jhum* fallow, cultivation, soil fertility

Introduction
Ramie (*Boehmeria nivea* L.) is considered as the oldest and valuable fibre crop, which is classified as an underutilized fibre. It is one of the strongest natural fibres having rich in cellulose content. Despite of the high potential and unique quality of fibre, ramie has received comparatively less prominence in the world due to various techno-economical reasons. China is the biggest producer of ramie followed by Brazil and Phillippines (Jose *et al.,* 2017) [2]. In India, a very few areas of North Bengal and Assam are cultivating ramie. Still there is a huge scope for expansion of ramie cultivation in North Eastern Region of India particularly in *jhum* fallow system. In Nagaland, farming system is largely dominated by *jhum* or shifting cultivation practice, which is associated with cutting and burning of natural forest for cultivation and finally land are left as abundant only after 1-3 years of cultivation and a new forest area is selected to repeat the same process. Presently, the system is characterized by low productivity and low income and the system is associated with numbers of inherent problems such as soil erosion, loss of nutrients and biodiversity. Of late, such problems accentuating due to reduction of *jhum* cycle to 3-5 years as compared to 10-15 years in the past. Now, the system is becoming an unsustainable and non-profitable and not capable to provide food and livelihood security (Mantel *et al.,* 2006) [3]. In spite of that 1.9 lakh tribal families are still practicing *jhum* cultivation covering an area of 1.24 lakh ha of Nagaland (ICAR, 2015) [1] and complete eradication of this method of cultivation is practically impossible. Therefore, promotion of ramie crop in *jhum* fallow system may be a viable intervention in view of its perennial surviving ability, extensive life span, 4-6 times annual harvesting and adaptive capability in wide range of soil and agro-climatic conditions. Keeping the above facts in mind, a field experiment was conducted with objectives to promote ramie cultivation in *jhum* fallow system, to find out the potential productive capacity of ramie, to assess the economic benefits of ramie cultivation and changes in soil fertility status after certain period of cultivation.

Materials and Methods
Study area
The experiment was initiated in the year 2014-15 at two villages of Wokha district, located in between $26^0$05'037" N to $26^0$06'437" N latitude and $94^0$12'110" E to $94^0$12'980" E longitude and 527 to 1125 m above the mean sea level.

Soil status

Soils of the site were clay loam in texture. According to rating limits of soil test values (Soltanpour and Schwab, 1977) [4], soil pH (4.22) was extremely acidic in nature, high in soil organic carbon (2.42%) content, low in available nitrogen (177.21 kg/ha) content, very low in available phosphorus (12.0 kg/ha) content and very high in soil available potassium (256.48 kg/ha) content respectively.

Ramie production technology details

Ramie plantlets (variety: *Hazarika*) were grown to cover an area of 6 ha with improved cultivation practice in the year 2014-15 involving 9 numbers of *jhum* farmers. Before conducting of the experiment, training was imparted on cultivation and extraction of ramie fibre. The full scientific cultivation package & practices were followed and special emphasis on soil and water conservation measures, fertilization based on initial soil nutrient results, maintenance of adequate spacing (30 cm x 60 cm) and plantation across the slopes. At the harvesting stage of crop, demonstration was given on ramie fibre extraction by using ramie fibre extraction machine at the experimental site.

Estimation of yield and fibre production

Ramie rhizome yield data was recorded from each of the experimental plots through random plot cutting method in three replications at each and every harvesting stage of the year. The raw fibre production was also recorded after extraction fibre from canes. The conversion ratio of the fibre production from cane to fibre was also estimated at each crop harvest.

Economic analysis of ramie cultivation

Cost of cultivation of ramie including cost of farm inputs such as fertilizers, pesticides and hiring of additional labour during planting, weeding and harvesting stages. The gross and net returns were worked out accordingly by taking cost of cultivation and production of raw fibre yield per hectare.

Results and Discussions

Crop performance and productivity

In the present study the cultivation of ramie was found to be a successful technological intervention in the *jhum* fallow area. It was noticed that the planting time of ramie during the month of February-March was ideal and the crop was harvested in four times in the year successfully. The annual ramie crop cane (ramie stem) yield was recorded to be 17410.67 kg/ha and 19410.67 kg/ha (Table 1) at 1st year and 2nd year of planting respectively. Similarly, fibre yield was recorded 1621 kg/ha in 1st year and 1815.33 kg/ha (Table 2) in 2nd year respectively. Relatively higher cane and fibre yield was noticed in 2nd years of harvest. The higher yield in 2nd year might be due to better root establishment that helps to absorb adequate water and nutrients from both the surface and sub-surface soils.

Table 1: Year and season-wise ramie cane yield

Year	Value	Fresh ramie cane yield (kg/ha) in different cuttings				Fresh cane yield (kg/ha/annum)
		1st	2nd	3rd	4th	
2015-16	Mean	4008.67±148	4497.00±216	4378.33±153	4526.67±205	17,410.67
	Range	3859-4155	4250-4652	4211-4512	4300-4700	16,620-17,813
2016-17	Mean	4467.33±216	4953.33±61	4802.67±115	5187.33±146.5	19,410.67
	Range	4230-4652	4890-5012	4698-4925	5085-5355	19,295-19,552

Further, it was recorded that the mean cane (ramie stem) yield in each cuttings (harvest) were varied from 4008.67 to 4526.67 kg/ha and 4467.33 to 5187.33 kg/ha (Table 1) in 1st and 2nd year respectively. Likewise, mean raw fibre yield in each cuttings were also ranged from 382.33 to 428.33 kg/ha and 411.33 to 475.67 kg/ha (Table 2) during 1st year and 2nd year of cultivation. The highest quantity of cane was harvested in 4th cuttings followed by 2nd cuttings and 3rd cuttings and the lowest harvest was in 1st cuttings in both the years. Similarly, cane yield was recorded highest in 4th cuttings irrespective of the years which might be due to favourable temperature and rainfall distribution during the growth period that provided optimum soil and crop growth environment for better performance as compared to the other growing periods.

Table 2: Year and season-wise ramie fibre yield

Year	Value	Ramie fibre yield (kg/ha) in different cuttings				Raw fibre yield (kg/ha/annum)
		1st	2nd	3rd	4th	
2015-16	Mean	382.33±13.57	410.67±4.51	399.67±11.06	428.33±6.51	1621±14.00
	Range	368-395	406-415	388-410	422-435	1611-1637
2016-17	Mean	411.33±10.5	465.67±12.89	462.67±8.02	475.67±10.07	1815.33±13.43
	Range	401-422	455-480	455-471	465-485	1800-1825

The percentage fibre content in ramie cane was ranged from 9.1 to 9.5% (Fig. 1) in the 1st year and 8.6 to 10.4% in 2nd year of cuttings respectively (Fig. 2). Higher percentage of harvested fibre indicated better quality of harvest. However, in both the year moderately less harvest was obtained in 1st cutting but the quality of fibre was found superior than other cuttings.

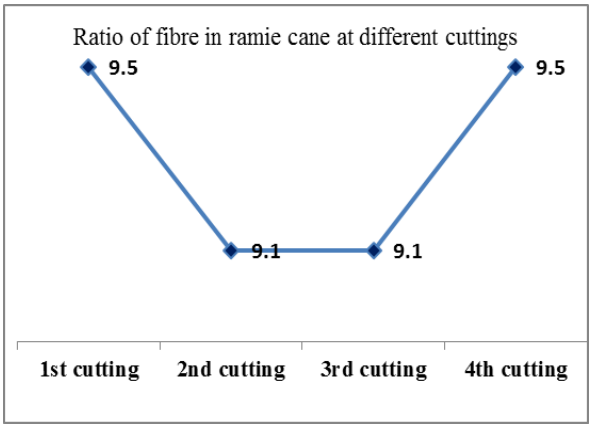

Fig 1: Ratio of fibre in ramie cane in 1st year of cuttings

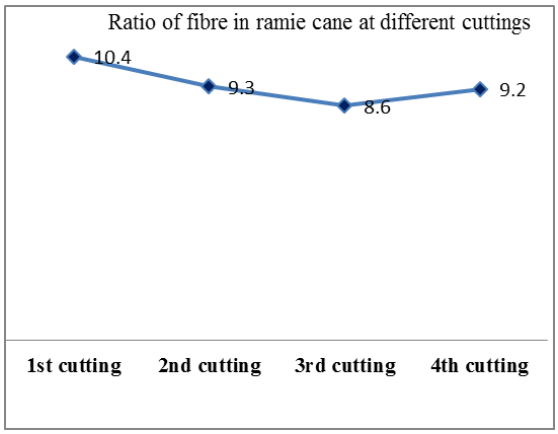

Fig 2: Ratio of fibre in ramie cane in 2nd year of cuttings

Economic analysis

The cost of ramie cultivation was recorded for Rs. 21,300 and Rs. 15,700/-ha for 1st and 2nd year respectively (Table 3). The higher cost of cultivation in 1st year was due to the additional manpower involvement for planting of plantlets. Similarly, higher gross returns fetched in 2nd year (Rs. 61,721/-) as compared to 1st year (Rs. 55,114/-) of cultivation, which might be attributed to the higher annual production in 2nd year. The two years net revenue varied widely from Rs. 33,814/- (1st year) to Rs. 46,021/-(2nd year) per/ha/year (Table 3) with net income ranged from Rs. 33,814/- to Rs.46,021/-. The higher net revenue was calculated in 2nd year due to less cultivation cost and higher fibre production. The B: C ratio was recorded as 2.59:1 in 1st year and 3.93:1 in 2nd year of ramie cultivation respectively.

Table 3: Economic analysis of ramie cultivation

Year	Raw fibre production (kg/ha)	Cost of cultivation (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	B:C ratio
2015-2016	1621.00	21,300	55,114	33,814	2.59:1
2016-2017	1815.33	15,700	61,721.2	46,021	3.93:1
Mean	1718.17	18,500	58,417.6	39,918	3.16:1

Changes in soil health status

The results (Table 4) indicated that the continuous cultivation of ramie in *jhum* fallow plays an important role to maintain the soil fertility status in *jhum* fallow system. The result showed that soil pH increased (4.33-4.67) significantly (at 5% level) at all the experimental plots from their initial range of 4.11 to 4.36 with pair mean difference of -0.297 after two years of planting. Implementation of a proper soil and water conservation measures and use of weed biomass as mulching materials also helped to increase soil organic carbon with pair mean difference of -0.019 and residual available N content (-4.515 kg/ha). The residual phosphorus decreased marginally by 0.95 kg/ha (mean difference) from their initial range of 11.5-12.5 kg/ha. Similarly, potassium content decreased by 19.963 kg/ha (mean difference) from their initial soil K range of 247.5 to 263.9 kg/ha.

Table 4: Paired t test on soil initial and final change values of different soil parameters

Parameters	Paired differences		df	T-statistic	Significantly different	
	Mean	SD			5% level	1% level
pH	-0.297	0.017	5	-3.579	√	
OC	-0.019	0.008	5	-2.803	√	
N	-4.515	1.240	5	-3.212	√	
P	0.950	0.245	5	2.884	√	
K	19.963	4.365	5	4.366	√	√

Conclusion

From the present study, it could be inferred that the cultivation of ramie fibre crop could be a viable intervention for management of *jhum* fallow areas to lead an income generating avenue for the *jhumias*.

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