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AGRONOMY

Response of Paddy Straw Mulching and Farmyard Manure in Colocasia under Jhum Fields in Zunheboto District of Nagaland

Sentimenla

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ABSTRACT

Farm Trials were conducted in the jhum fields of Zunheboto district under rainfed conditions to observe the Effect Of Paddy Straw Mulching and FYM in Colocasia crop. Three jhum fields of Lumami village were selected for each one-hectare area. Colocasia being an essential crop of this area, was selected for the trial. It was observed that the use of Paddy Straw Mulching @ 12t ha^{-1} at 3 cm thickness and FYM@ 10t ha^{-1} increased the soil moisture and reduced the soil temperature as compared to the farmers' practice. The mean temperature at 15, 30, and 45 DAP in the trial plot ranged from 26.2, 30.3 to 31.7 °C and mean soil moisture at 45 DAP from 5cm depth was 28.9 % as compared to the farmers practice were the mean temperature was higher, ranging from 27.0, 32.3 and 32.5°C and mean moisture of 22.2% where paddy straw mulching was not used. The mean yield, net income, and B:C ratio were also increased to 3030 kg ha^{-1}, ₹ 1,01033, and 3.00 over farmers practice of 2292 kg ha^{-1}, ₹ 64,100, and 2.27.

HIGHLIGHTS

- Application of paddy straw @ 12 t ha^{-1} at 3 cm thickness and FYM@ 10 t ha^{-1} in colocasia crop have decreased the soil temperature and increased the soil moisture in the jhum fields.
- The yield, net income, and B:C ratio were also enhanced.
- The soil fertility status was also improved.

Keywords: B:C ratio, Colocasia, FYM, Mulching, Paddy straw

Colocasia or taro (*Colocasia esculanta* L.) is an important tuber crop widely grown worldwide. India is one of the center origins where it is grown in a wide range of soils with pH ranging from 5.5 to 7 between 21.- 27°C temperature. It is rich in vitamins, minerals and is a rich source of protein and dietary fiber (Temesgen 2015). It contents starch (70–80 g/100 g dry taro), fiber (0.8%), ash (1.2%), fat (0.2%) and protein (1.5%) (Rashmi *et al*. 2018). In India, about 48% of the food crops and 68% of non-food crops areas are under rainfed, where farming is practiced in a wide-range of agro-climatic conditions, soil type, and rainfall ranging between 400mm 1600 mm $year^{-1}$. In the North-Eastern region of India, it is cultivated on a large scale because of its nutritional quality and as a means of income generation (Buragohain *et al*. 2013). The corms, cornel, and leaves are the edible part of the plant. In Nagaland, it is cultivated under rainfed conditions, and it is considered an important crop next to rice (Mezhii *et al*. 2017). Being a rainfed crop, it is prone to poor growth or crop failure due to insufficient moisture. Moisture conservation becomes an important practice to provide sufficient moisture and enhance the growth

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and yield of the crop under rainfed conditions. Mulching is a technique of covering the surface soil to reduce water loss and improve moisture retention, maintain soil temperature, control soil erosion and weed growth (Yang *et al*. 2003). The use of organic mulch like paddy straw helps in moisture conservation and adds nutrients into the soil under rainfed cultivation (Chakraborty *et al*. 2008). The use of paddy straw as mulch also adds 6g of nitrogen and 0.8g of phosphorus per kg of paddy straw. It improves the soil's physical, chemical, and biological properties such as pH, organic carbon, water holding capacity, bulk density and prevents the leaching of nitrates over a period (Kumar *et al*. 2014). Almost all the areas under shifting cultivation in Nagaland are rainfed, where Zunheboto district accounts for 23.29 thousand ha area where colocasia crop occupies 0.20 thousand hectares (Anonymous, 2018). However, its productivity per hectare is less. The average rainfall in the district is about 200 cm and receives heavy rainfall from July to August but due to climatic changes, the rainfall pattern is often affected, resulting in low productivity of the crop. Considering straw mulching as an important technique to maintain soil temperature, soil moisture, soil conservation, and adds nutrients into the soil, this trial on paddy straw mulching in colocasia was undertaken in Lumami village under Zunheboto district to assess the Soil temperature, soil moisture, yield, economics and soil fertility status of the soil. The observations were then compared with the farmer's practice where paddy straw mulching was not applied.

MATERIALS AND METHODS

An -farm trial was conducted at three locations under Lumami village covering 1 ha each of jhum fields under the Zunheboto district of Nagaland during 2018-19. For this trial, three locations were selected under jhum fields. Materials used were local variety colocasia @ 800kg ha^{-1}, paddy straw mulching @ 12t ha^{-1} at 3 cm thickness, and FYM@ 10t ha^{-1} and irrigation at 1-week interval. The soil status of the fields was pH ranging from 5.5 to 6.5, 0.30 to 0.55% organic carbon, 235 to 245 kg ha^{-1} available nitrogen, 17.50 to 18.32 kg ha^{-1} available phosphorus, and 135-159 kg ha^{-1} of available potassium. The crop was sown in the month of May 2018 and harvested in October. Parameters such as soil temperature were measured at 0-5cm depth @15, 30, and 45 days after planting, soil moisture at 45 days after planting where irrigation was done at one week intervals, yield, B:C ratio, and soil fertility status of the soils after harvest were recorded. The soil temperature, soil moisture, available soil nitrogen, phosphorus, and potassium were analyzed using soil thermometer, Gravimetric method, alkaline $KMnO_4$ distillation method (Subbiah and Asija 1956), Bray's No. 1 method (Bray and Kurtz 1945), flame photometer (Jackson 1973). The soil moisture content was determined by digging out soils with the help of an auger from 5 cm depth in the field. The fresh soil is weighed, and then oven-dried at 105^{o}C for 24 hours. The soil moisture content is then measured using fresh soil samples and oven-dried soil samples by using the formula:

Soil moisture content =

$$\frac{\text{Fresh weight soil (g)} - \text{Dry weight soil (g)}}{\text{Dry weight soil (g)}} \times 100$$

RESULTS AND DISCUSSION

The results shown in table 1 indicate that the soil temperature is reduced and the soil moisture is increased in the trial plots of jhum fields with paddy straw mulch @ 12 t ha^{-1} at 3 cm thickness and FYM@ 10 t ha^{-1} as compared to the farmers' practice. The mean temperature at 15, 30 and 45 DAP in the trial plot ranged from 26.2, 30.3 to 31.7 ^{o}C. The mean soil moisture at 45 DAP was 28.9 % as compared to the farmers' practice, where mean temperature was higher, ranging from 27.0, 32.3 and 32.5^{o}C and mean moisture of 22.2%. Suminarti *et al*. (2020) reported suppression of the maximum soil temperature of 4.41, 5.17, 5.07 and an increase in soil moisture by 4.9^{o}C using 10 cm mulch length and 2, 4, 6 and 8cm thickness of paddy straw mulch in beetroot. Mulching also helps insulate the soil by providing a buffer for soil temperatures (Kader *et al*. 2019). Miyasaka *et al*. (2001) also reported an increased in soil moisture content due to paddy straw mulching in taro crops under rainfed conditions. This is because of the soil moisture being conserved in the soil through mulching which creates a microclimatic soil condition, controls weeds, reduces evaporation, and increases infiltration of water (Yang *et al*. 2003). Through mulch decomposition and humus formation, soil water holding capacity can also be

Table 1: Effect of paddy straw mulching on soil temperature and soil moisture of colocasia crop

Location	Soil temperature (°C)						Soil moisture (%)	
	15 DAP		30 DAP		45 DAP		(At 45 DAP)	
	FP	TP	FP	TP	FP	TP	FP	TP
Jhum 1	27.3	26.8	31.5	30.3	32.5	31.6	21.5	25.7
Jhum 2	27.6	26.5	31.9	29.9	32.1	31.9	22.8	31.5
Jhum 3	26.0	25.2	32.7	31.3	32.8	31.6	22.2	29.6
Mean	27.0	26.2	32.3	30.3	32.5	31.7	22.2	28.9

Table 2: Effect of paddy straw mulching on yield and economics of colocasia

Location	Yield (kg ha^{-1})		Gross income (₹)		Net income (₹)		B:C ratio	
	FP	TP	FP	TP	FP	TP	FP	TP
Jhum 1	2256	3080	1,12800	1,54000	62,300	1,03500	2.23	3.05
Jhum 2	2340	2892	1,17000	1,17000	66,500	94,100	2.32	2.86
Jhum 3	2280	3120	1,14000	1,56,000	63,500	1,05500	2.26	3.09
Mean	2292	3030	1,14600	1,51,533	64,100	1,01033	2.27	3.00

Table 3: Effect of paddy straw mulching on soil fertility status of colocasia crop after harvest

Location	Available N (Kg ha^{-1})		Available P (Kg ha^{-1})		Available K (Kg ha^{-1})	
	FP	TP	FP	TP	FP	TP
Jhum 1	276.30	299.10	20.21	27.67	161.70	224.23
Jhum 2	280.12	311.22	20.98	27.97	162.78	218.14
Jhum 3	284.23	329.34	21.67	28.45	185.98	245.56
Mean	280.22	313.22	20.95	28.03	170.15	229.31

**DAP – Days after planting; *FP – Farmers practice; *TP – Trial plots.*

improved (Ji *et al*. 2001). About 34-50 % reduction in soil water evaporation can be achieved through mulching with crop residue (Hatfield *et al*. 2001).

The mean yield, net income, and B:C ratio per hectare from the trial plots in the jhum fields were found to be higher with the use of paddy straw as mulching and fym in colocasia (Table 2). Its mean yield, net income, and B:C ratio were 3030 kg ha^{-1}, ₹ 101,033, and 3.00 over farmers practice of 2292 kg ha^{-1}, ₹ 64,100, and 2.27. This increased yield may be due to the decay of organic mulch adding up soil nutrients, leading to its nutrient availability in the long run (Larentzaki *et al.* 2008). Ram *et al*. (2013) also reported an increase in the grain yield of wheat due to straw mulch. A similar observation was also reported in potatoes where yield was 24.04% higher in mulch conditions which might be due to sufficient moisture in the initial growth stage (Begum *et al*. 2014). Application of straw mulch in wheat which receives five irrigations, gives the highest net return (Brahma *et al*. 2007). Use of rice straw @ 10 t ha^{-1} in rabi-summer tomato found to increase the fruit yield, net income, and B: C ratio and at the same time control weeds and conserve soil moisture (Pandey *et al*. 2012).

The soil fertility status in the trial plots was also improved. The mean available nitrogen, phosphorus, and potassium were 313.22, 28.03, and 229.31 kg ha^{-1} as compared to farmer's practice i.e. 280.22, 20.95, and 133.49 kg ha^{-1} (Table 3). Khan *et al*. (2002) also reported an increase in soil available nitrogen, phosphorus and potassium due to paddy straw mulching in soil. Application of paddy straw mulch in rape seed-green gram-rice cropping system also increased the N, P, K availability in the soil (Mitra and Mandal 2012). The soil fertility is also improved through mulching over some time due to nutrient cycling through earthworm activity in the soil (Kader *et al.* 2017 and Qin *et al.* 2015).

CONCLUSION

From the trials conducted in jhum fields of Lumami village under Zunheboto district of Nagaland, application of paddy straw @ 12 t ha^{-1} at 3 cm thickness and FYM@ 10 t ha^{-1} in colocasia crop have shown to decrease the soil temperature and increase the soil moisture in the jhum fields. The yield, net income, B:C ratio, and soil fertility status were also found to increase from the trials compared to farmers' practice. Thus, from the on-farm trials conducted under rainfed conditions, it was shown that the use of Paddy Straw Mulching and FYM in Colocasia crop in the jhum fields can could help to improve moisture conservation regulate the soil temperature, enhanced soil fertility over some time. Thereby increasing productivity and also enhanced income generation for livelihood.

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