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Mulching implication on soil moisture, growth and yield response of potato *Solanum tuberosum*– local cultivar (Thangal Alu)

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ABSTRACT

An experiment was conducted during rabi season at the research farm of Agronomy, College of Agriculture, Central Agricultural University, Imphal, 2011-2013. The results of the experiment revealed that T_6 (10 t ha^{-1} of rice husk) produced the maximum plant height, number of leaves, number of stem hill^{-1}, maximum fresh and dry weights of aerial portion hill^{-1}. Significantly highest soil moisture content was found in T_7 (11 t ha^{-1} of rice husk) compared to other treatments. The weight of tubers hill^{-1} (288.60 g hill^{-1}) and yield per hectare (95.77 q ha^{-1}) was significantly recorded highest with T_6 (10 t ha^{-1} with rice husk) treatments. Yields were statistically same by using mulch @ 7, 8, 9 and 11 t ha^{-1}. Almost all the parameter recorded, T_1 (control) treatment reveals lowest values compared to others. Harvest index showed some variation among the treatments but not up to the level of significant. T_5 (9 t ha^{-1} with rice husk) gave the maximum value of harvest index. The highest net return of Rs.292138 ha^{-1} was obtained by growing potato mulching with 10 t ha^{-1} of rice husk (T_6) which was followed by the mulching with 9 t ha^{-1} of rice husk (T_5) of Rs.245380 ha^{-1} with a benefit: cost ratio of 4.2 and 3.7, respectively.

Keywords : Mulching, potato, rice husk, soil moisture, yield

Potato (*Solanum tuberosum*) is the most dominating starchy, tuber crop mainly grown in the *rabi* season in Manipur state and is grown in around 1690 ha area producing around 15196 MT with an average productivity of 8.99 t ha^{-1}. Potato is one of the most important crops of the world which is next to rice, wheat and maize. But in India, due to our traditional food habits, we continued to depend upon cereals. Potato contains all major nutrients like protein, vitamins, calcium, phosphorus and is a treasure house of carbohydrates which are essential for the body building. Potato is one of the richest sources of calories needed to maintain day to day output of human energy (Das, 2000). Rainfed cultivation is the main reason for low productivity in the state because the potato growing season coincides with moisture stress resulting from cool and dry winter season. High evaporation rate and low amount of rainfall during that period reduced the moisture from the soil surface and creates a drought like situation which reduced the yield. Potato is very sensitive to water stress and even short term water stress can cause significant reduction in yield (Haverkot, *et al*., 1995). Mulching is provided to maintain the soil moisture without any waste of water by reducing the soil evaporation loss. Organic mulches add nutrients to soil when decomposed by microbes. Favourable soil edaphic environment under mulch improves crop productivity, enhances input-use efficiency and checks environmental pollution (Acharya, *et al*., 2005). So far no mulching with rice husk has been done with potato in Manipur. Therefore, the present investigation on the study of the effect of rice husk mulching on the yield of potato (local cultivar "Thangal Alu") is being taken.

MATERIALS AND METHODS

The study site is located in North-East India with 24^{0}46′ N and 93^{0}54′ E an altitude of 774.5 meters above the sea level. The mean minimum and maximum temperatures recorded during the cropping season were 9.48^{0}C and 24.18^{0}C respectively. The average rainfall recorded during the experiment was 77.03 mm, average relative humidity was 77.97 per cent and average Sunshine hour was 2.85 hrs. The soil in the experimental field was clayey in texture with pH of 5.91, containing available N 375.21 kg ha^{-1}, phosphorus 29.86 kg ha^{-1} and potash 124.95 kg ha^{-1}. The experiment was laid out in randomized block design with three replications consisting of seven different doses/quantities of rice husk mulch {*i.e*., without rise husk (control, T_1), mulching with 6 t ha^{-1} rice husk (T_2), with 7 t ha^{-1} of rice husk (T_3), with 8 t ha^{-1} of rice husk (T_4), with 9 t ha^{-1} of rice husk (T_5), with 10 t ha^{-1} of rice husk (T_6) and with 11 t ha^{-1} of rice husk (T_7)}. Seeds of the variety Thangal Alu were used for planting in the plots 2 × 3 m^2 with spacing of 45 × 20 cm^2. The crop was raised using all the recommended cultural practices except mulching treatments. Different mulching materials were placed one week after planting. After 45 days of planting, mulches were removed and reapplied immediately after the completion of earthing and top dressing of N. The soil moisture percentage were recorded in every stages (30, 60, 90 DAP). The growth parameters (Plant height, Number of leaves) were also recorded. Hardening process takes place at 120 DAP and kept for 10 Days in the field and crops was harvested at 130 DAP. Data on No. of stem hill^{-1}, fresh weight of aerial portion hill^{-1} (g), Dry weight of aerial portion

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Table 1: Effect of mulching on growth characters and soil moisture content of potato-crop

Treatment	Plant height (cm) 90 DAP	Number of leaves at 90 DAP	Soil Moisture (%)			No. of stem plant^{-1} at harvest
			30 DAP	60 DAP	90 DAP	
T_1	23.43	14.32	15.8	16.03	10.96	3.00
T_2	24.7	14.77	17.84	19.57	13.15	3.68
T_3	25.31	15.43	18.41	19.76	14.2	4.42
T_4	26.15	15.63	18.92	19.83	14.32	4.63
T_5	26.87	16.1	19.32	20.33	15.95	4.8
T_6	27.51	16.57	19.49	20.69	16.84	4.88
T_7	26.33	15.71	19.92	20.92	17.43	4.7
SE(d)	**1.00**	**0.60**	**1.02**	**1.09**	**1.31**	**0.33**
LSD(0.05)	**2.18**	**1.31**	**2.21**	**2.37**	**2.86**	**0.72**

Note : T_1- without rise husk (control), T_2- mulching with 6 t ha^{-1} rice husk, T_3- with 7 t ha^{-1} of rice husk, T_4- with 8 t ha^{-1} of rice husk, T_5- with 9 t ha^{-1} of rice husk, T_6- with 10 t ha^{-1} of rice husk, T_7- with 11 t ha^{-1} of rice husk

Table 2: Effect of mulching on yield attributes, yield and economics of potato crop

Treatment	Fresh weight of aerial portion hill^{-1} (g)	Dry weight of aerial portion hill^{-1} (g)	Weight of tubers hill^{-1} (g)	Tuber yield (q ha^{-1})	Harvest index	B : C ratio
T_1	32.31	8	236.7	25.39	84.87	1.1
T_2	34.58	9.01	253.78	69.77	87.92	3.1
T_3	35.25	9.21	259.86	71.38	87.97	3.2
T_4	36.52	9.52	269.44	79.22	87.97	3.5
T_5	38.16	9.95	285.64	84.05	88.07	3.7
T_6	39.13	10.22	288.6	95.77	87.94	4.2
T_7	37.63	9.82	277.2	73.22	87.93	3.2
SE(d)	**0.69**	**0.21**	**5.56**	**11.62**	**1.80**	
LSD(0.05)	**1.50**	**0.45**	**12.12**	**25.32**	**3.92**	

Note : T_1- without rise husk (control), T_2- mulching with 6 t ha^{-1} rice husk, T_3- with 7 t ha^{-1} of rice husk, T_4- with 8 t ha^{-1} of rice husk, T_5- with 9 t ha^{-1} of rice husk, T_6- with 10 t ha^{-1} of rice husk, T_7- with 11 t ha^{-1} of rice husk

hill^{-1} (g), weight of tubers hill^{-1} (g), Tuber yield (q ha^{-1}) and harvest index was recorded.

RESULTS AND DISCUSION

Growth and yield attributes

The plants treated with 10 t ha^{-1} of rice husk (T_6) at 90 DAP recorded highest plant height (27.51 cm) and number of leaves (16.57 cm). The beneficial effect of mulching on plant height was also reported by Zhao Hong Xiong *et al*. (2012). Mulching showed significant increases in number of leaves was reported by Zhang Yun Qi *et al*. (2004). The data on moisture status of the soil was found to be highest with 11 t ha^{-1} of rice husk (T_7) treatment recorded at 30 (19.92%), 60 (20.92%) and 90 DAP (17.43%). This might be due to a better conservation of soil moisture by the mulch and it reduced irrigation water required and evapo-transpiration. This finding was supported by G. Kar and A. Kumar (2007) and Hou Xiao Yan (2010). There were significant responses on number of stem hill^{-1} among the treatments over control and T_6 recorded the maximum number of stems per hill at hardening, this might be due to the uptake of phosphorus and potassium were increased by mulching (Khalak and Kumaraswamy, 1992). Mulching with 10 t ha^{-1} of rice husk (T_6) significantly increased the number of stem plant^{-1} over T_1 (Control) and T_2 (with 6 t ha^{-1} of rice husk) but remained at par with T_3, T_4, T_5 and T_7. N. Singh and Z. Ahmed (2008) reported that number of stems was improved with black polythene mulching. The fresh weight and dry weight of aerial portion hill^{-1} increased significantly with the application of different levels of mulching at hardening time. The maximum increase in fresh aerial weight per hill was recorded in T_6 (with 10 t ha^{-1} of rice husk). The mulches had significant influence on fresh shoot weight was reported by Uniyal and Mishra (2003). There is more

accumulation of dry matter in plant due to mulching. These findings are in accordance with those reported earlier by Taja *et al*. (1986).

Fresh weight of tubers per plant and tuber yield increased significantly with mulching. The maximum increase of tuber fresh weight and tuber yields was with T_6 (with 10 t ha^{-1} of rice husk) significantly different from other treatment, but remained at par with T_5 (with 9 t ha^{-1} of rice husk) and T_7 (with 11 t ha^{-1} of rice husk) over control. Higher tuber yield in plots mulched with 10 q ha^{-1} rice husk might be due to the ability of these mulches to conserve high soil moisture and reduce maximum soil temperature, favouring plant growth and tuber bulking, respectively. The result confirms the finding of Lin Ye Chun Bu *et al*. (2012) and Mukherjee *et al*. (2012). Harvest index is one of the most stable physiological traits for higher tuber yield. Higher harvest index was recorded with T_5 (with 9 t ha^{-1} of rice husk) but no significant difference was obtained. The higher harvest index with the application of nitrogen can be attributed to improvement in growth resulted in significant increases in yield attributes like plant height, number of leaves, number of stems $hill^{-1}$, number and weight of tubers $hill^{-1}$ which ultimately contributed to higher tuber yield resulted in increasing in harvest index.

Economics

All the husk mulched treatments showed higher gross return, net return and benefit: cost ratio over control. The highest net return (Rs. 292138 ha^{-1}), gross return (Rs. 383080 ha^{-1}), benefit: cost ratio (4.212) was obtained by the treatment T_6 (mulching with 10t ha^{-1} of rice husk) followed by T_5 (mulching with 9 t ha^{-1} of rice husk). The tuber yield was highest in T_6 (95.77 q ha^{-1}) followed by T_5 (84.05 q ha^{-1}), the tuber yield in T_6 and T_5 were statistically at par. The highest cost of cultivation was associated with T_7 (with 11 t ha^{-1} of rice husk) with a value of Rs. 91186 and the lowest value of net return of Rs. 12814 ha^{-1} was observed in T_1 (control). This finding is also supported by Rahaman *et al*. (2004).

The given experiment concluded that, the rice husk treated plot with 10 t ha^{-1} (T_6) recorded maximum plant height, number of stem per hill, maximum fresh and dry weights of aerial portion per hill, yield and yield attributes as well as the economic net return including cost : benefit ratio. But the moisture content of soil was recorded in the plot treated with 11 t ha^{-1} of rice husk (T_7) compared to other treatments.

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