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## Effect of Different Mulches on Potato at the Saline Soil of Southeastern Bangladesh

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**Abstract:** The present study was carried out to observe the effect of different mulches on the production of potato (*Solanum tuberosum*). Treatments with mulches-rice straw, water hyacinth and wastage of rice straw significantly increased potato yield over control. Salinity was found to be higher in the treatment without mulch than different mulch materials during the experimental period. From the average of two years results, it was found that highest yield (23.02 ton ha<sup>-1</sup>) and gross margin (TK69425) obtained by rice straw mulch followed by water hyacinth mulch with yield 22.23 ton ha<sup>-1</sup> and gross margin TK 66084. The benefit cost ratio was found to be highest (2.51) in rice straw followed by water hyacinth (2.46), wastage of rice straw (2.08) and no mulch (1.69). The results indicate that potato could be cultivated in saline soil by minimizing salinity with application of mulch.

**Key words:** Potato, mulch, salinity, Bangladesh

### INTRODUCTION

Potato (*Solanum tuberosum*) is an important tuber crop in Bangladesh and it is used in many culinary preparations. Its cultivation area is 136331.98 ha. and production is 1553180 tons in Bangladesh, whereas in greater Noakhali the production area is only 1080.97 ha. (BBS, 1997). Salinity is an important determinant for soil capability as a “modifier” which put restrictions on possible crop choices (Wilde, 2000). Transplanted Aman paddy is the principal crop grown in the entire cropping area of Noakhali and after late harvest of T. aman, salinity increases in the upper soil layers through capillary rise due to evaporative demand. When the water evaporates, the salts are left behind on the soil surface. High salinity restricts crop production during late Rabi and early Kharif 1 seasons (Hussain *et al.*, 1999) and salinity acts like drought on plants, preventing roots from performing their osmotic activity where water and nutrients move from an area of low concentration.

So, escaping or minimizing soil salinity is very important for the Rabi crop cultivation of saline soils of Noakhali. It was reported that mulching with rice straw, water hyacinth and wastage of rice straw produced higher yield of potato at the FSRD site, Atkapalia, Noakhali (Anonymous, 1999-2000). The potato tuber yield enhancement by mulching was due to conservation of soil moisture and minimizing soil salinity (Anonymous, 2001). Begum *et al.* (1998) reported that the mulch (water hyacinth) had significantly increased potato yield over control. The production technique mainly includes conservation of residual soil moisture (Mandal, 1986); reduction of turn around time and in time planting of

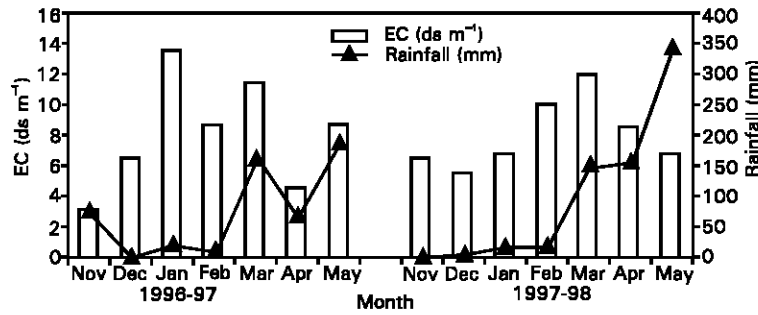
crops. The mulch prevents evaporation. It was observed that mulch improved the yield of different vegetables like potato, tomato, brinjal and cabbage. Improvement of yield due to mulch of potato was 49.32% at the saline soil (Anonymous, 2000).

But the use of mulch (water hyacinth) in potato has been in practice and it is established that mulch minimize evaporation loss and enhance root growth (Allamanas *et al.*, 1977; Choudhury and Prihar, 1974). There are limitations, in part because relatively little agricultural research in Bangladesh had been done with salinity management for Rabi crop. So, it was important to know the effect of different mulches viz. water hyacinth, rice straw and wastage of rice straw in the production of potato.

### MATERIALS AND METHODS

The experiment was conducted at farmer's field under Farming Systems Research and Development (FSRD) site, Atkapalia, Noakhali, during the winter season of 1999-2000 and 2000-2001. The soil was silt loam to silty clay loam (Karim *et al.*, 1990) under the Ramgati soil series of AEZ 18f (Young Meghna Estuarine Flood plain). Organic matter content, pH, nitrogen, phosphorus, potassium, zinc and sulphur of soils were 1.41%, 7.06, 0.03%, 5.7 µg g<sup>-1</sup> soil, 0.231 meq per 100 g soil, 0.66 µg g<sup>-1</sup> soil and 65.2 µg g<sup>-1</sup> soil, respectively.

Different mulch treatments i.e., no mulch (T<sub>1</sub>), wastage of rice straw (T<sub>2</sub>), water hyacinth (T<sub>3</sub>) and rice straw (T<sub>4</sub>) amounting 4.0 ton ha<sup>-1</sup> were tested against control (no mulch) treatment. The experiment was conducted under randomized complete block design with



Source: SRDI, Noakhali, 2000

Fig. 1: Salinity and Rainfall data of Atkapalia, Noakhali during previous year 1996-97 and 1997-98

six dispersed replications having unit plot size of 8x5 m. The experimental site experiences a year-to-year variation of salinity on the basis of rainfall. According to monitoring data of SRDI, Noakhali (Anonymous, 2000) trend of soil salinity (0-130 cm depth) and rainfall of the nearest site Char Jublee during the previous two years (1996-97 and 1997-98) was shown in Fig. 1.

The crop was fertilized with N-P-K -Zn (165-32-57-3) and cowdung at the rate of 5 t ha<sup>-1</sup> to achieve high yield goal on the basis of Fertilizer Recommendation Guide-1997, BARC. All fertilizers were applied at the final land preparation as basal. The whole potato tubers of the variety Diamont were planted within 20-23 November, in both the years. Mulches were applied immediately after planting to check the loss of soil moisture. The crop was grown under rainfed situation and harvested during 4th week of February. Data regarding yield was collected from each plot by avoiding 1m border area from each side 10 hills were selected randomly for collecting all the yield contributing factors. Electrical conductivity in soil solution was measured using conductivity bridge (Model-EIJKLKAMP pH/EC 18.38). All the data were recorded at the time of harvest and were statistically analyzed. The means were compared by Least Significant Differences (LSD) test. Moreover, input prices were recorded for cost and return analysis.

## RESULTS AND DISCUSSION

Soil salinity (Electrical conductivity, EC) was determined at every 15 days interval during the experimental period. Electrical conductivity of the experimental plot before planting of potato tuber were 2.2 dsm<sup>-1</sup> in the year 1999 and 2.32 dsm<sup>-1</sup> in the year 2000 (Fig. 2). In the harvesting stage (22 February), the highest EC (7.8 dsm<sup>-1</sup>) was found in T<sub>1</sub> followed by T<sub>2</sub>(6.9 dsm<sup>-1</sup>), T<sub>3</sub> (5.6 dsm<sup>-1</sup>) and T<sub>4</sub> (5.2 dsm<sup>-1</sup>) during 1999-00. On the other hand, during 2000-01, the highest

salinity (EC, 6.6 dsm<sup>-1</sup>) was recorded in T<sub>1</sub> followed by T<sub>2</sub> (5.4 dsm<sup>-1</sup>), T<sub>3</sub> (5.2 dsm<sup>-1</sup>) and T<sub>4</sub> (4.8 dsm<sup>-1</sup>) in the harvesting stage. The lower EC in mulched plot may be attributed to protection of evaporation due to mulch that hindered the build up of salinity. FAO (2001) reported the significant reduction of soil salinity due to mulch.

In the year 2000, after 2 days of planting of potato, salinity level declined when a heavy rainfall amounting 43 mm occurred during 4th week of December. After that salinity increased gradually upto harvesting period. But the higher salinity was observed with no mulch treatment (6.6 ds m<sup>-1</sup>) followed by wastage of rice straw (5.4 ds m<sup>-1</sup>), rice straw (5.2 ds m<sup>-1</sup>) and water hyacinth (4.9 ds m<sup>-1</sup>) during the harvesting period of potato.

Different mulches affected plant height, number of tuber per plant and tuber weight per plant and tuber yield ha<sup>-1</sup> significantly over control (Table 1 and 2). The higher plant height 60 cm during 1999-2000 and 67 cm during 2000-01 were obtained from the treatment rice straw mulch. The lowest plant height 42 and 52 cm, respectively were recorded from the control (no mulch) treatment during both the season. Treatments rice straw and water hyacinth produced significant difference over control treatment. But rice straw and water hyacinth showed statistically similar plant height in both the year. The plant height was poor in no mulch treatment due to higher salinity in the root zone and salinity prevents the plants from taking up the proper nutrients they require for healthy growth (Salt tolerance of plants). Anonymous (2001) reported similar reduction of plant height of potato in no mulch treatment than in rice straw mulch treatment.

Higher number of tubers produced per plant by the mulch treatment rice straw (10.07) followed by water hyacinth (9.80), wastage of rice straw (7.53) and control (6.33) during 1999-2000 (Table 1). Same trend was found in the season 2000-01 (Table 2). Similar results were reported by Anonymous (2001).

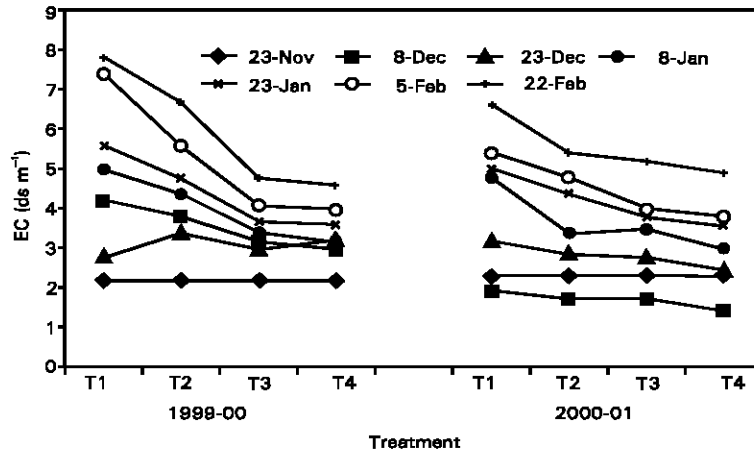


Fig. 2: Soil salinity of Atkapalia, Noakhali during the experimental period of 1999 and 2000

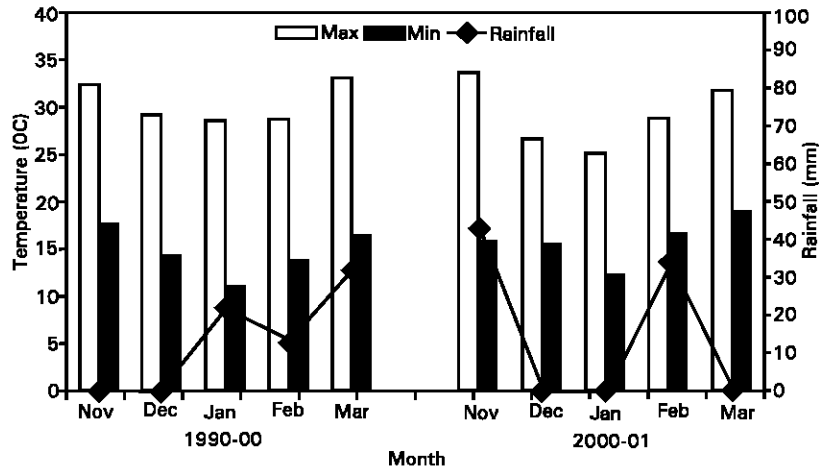


Fig. 3: Temperature and Rainfall data of the experimental site during 1999-00 and 2000-01

Table 1: Effect of different mulches on the yield and yield parameters of potato at FSRD site, Atkapalia, Noakhali during the winter of 1999-2000

Treatment	Plant ht (cm)	No. of tuber per hill	Tuber wt. per hill (g)	Tuber yield (ton ha <sup>-1</sup> )
T <sub>1</sub>	41.6	6.33	392.7	11.32
T <sub>2</sub>	45.4	7.53	420.7	14.32
T <sub>3</sub>	59.1	9.80	448.8	16.52
T <sub>4</sub>	59.8	10.07	454.3	17.23
CV%	10.8	11.06	12.34	7.57
LSD (0.05)	3.7	1.14	12.37	1.38

Table 2: Effect of different mulches on the yield and yield parameters of potato at FSRD site, Atkapalia, Noakhali during the winter of 2000-2001

Treatment	Plant ht (cm)	No. of tuber per hill	Tuber wt. per hill (g)	Tuber yield (ton ha <sup>-1</sup> )
T <sub>1</sub>	52.18	8.63	420.3	16.80
T <sub>2</sub>	60.65	10.17	475.7	21.83
T <sub>3</sub>	64.44	10.81	590.7	27.95
T <sub>4</sub>	67.20	11.27	612.3	28.81
CV%	9.69	13.91	8.30	14.48
LSD (0.05)	4.07	0.74	53.57	4.25

Table 3: Profitability level of different mulches on the yield of potato at FSRD site, Aakapalia, during the winter seasons of 1999-00 and 2000-01

Treatment	Mean yield (ton ha <sup>-1</sup> )	Gross return (Tk)	Total variable cost (Tk)	Gross margin (Tk)	BCR
T <sub>1</sub>	14.06	70300	41535	28765	1.69
T <sub>2</sub>	18.07	90350	43231	47119	2.08
T <sub>3</sub>	22.23	111150	45066	66084	2.46
T <sub>4</sub>	23.02	115100	45675	69425	2.51

The weight of tubers per plant was recorded highest 454.3 and 612.3 gm during 1999-00 and 2000-01 in rice straw mulch. In both the years tuber weight per plant was statistically similar to water hyacinth mulch (448.8 g in 1999-00 and 590.7 g in 2000-01). The lowest weight of tubers per plant was recorded by control treatment 392.7 and 420.3g during 1999-00 and 2000-01, respectively (Table 1 and 2).

Different mulch treatments rice straw, water hyacinth and wastage of rice straw produced significant yield difference over control (Table 1 and 2). Highest yield was found from rice straw 17.23 t ha<sup>-1</sup> during 1999-2000 and 28.81 t ha<sup>-1</sup> during 2000-01 followed by water hyacinth (16.52 t ha<sup>-1</sup> in 1999-2000 and 27.95 t ha<sup>-1</sup> in 2000-01), wastage of rice straw (14.32 ton ha<sup>-1</sup> in 1999-00 and 21.83 t ha<sup>-1</sup> in 2000-01) and control (11.32 t ha<sup>-1</sup> in 1999-2000 and 16.80 t ha<sup>-1</sup> in 2000-01). Mulching is reported to have conserved soil moisture, reduced soil temperature, minimize evaporation loss and enhanced root growth (Allamanas *et al.*, 1977; Chowdhury and Prihar, 1979). The use of water hyacinth mulch in potato cultivation has been in practice in some areas for a long time. According to Quayyum and Ahmed (1993) straw mulch produced better yield in maize (2575 kg ha<sup>-1</sup>) than water hyacinth mulch (2240 kg ha<sup>-1</sup>). Potato was reported to be tolerant up to EC 4 dsm<sup>-1</sup> (Mckenzie, 1988). The trial was conducted under the rainfed situation, but rainfall occurred at the end of November 2000 amounting 43 mm might have contributed to good yield during that season. Otherwise these soils generally have good physical properties.

**Input and out put cost:** Urea-6 Tk/Kg, TSP-14, MP-10, ZnSo<sub>4</sub>-50, Cow dung- 0.50, Labour-70 Tk/day, Ploughing by power tiller 2000 Tk/ha, Lining, Planting and earthing up -2450 Tk/ha, Wastage of rice straw 500Tk/ha, Rice straw 2000, Water hyacinth 1400, Pesticide 2280, Harvesting and carrying, control- 2450, Wastage of Rice Straw-3050, Rice straw-3500, Water hyacinth-3290, Fertilizer cost 7070, Cow dung 2500, Potato seed 15 Tk/Kg and Selling at farm gate 5Tk/kg.

**Profitability analysis:** The economic profitability level obtained from different mulching materials over years was given in Table 3. It reveals that mulching with rice straw showed the highest gross return Tk. 111150 ha<sup>-1</sup> followed by Tk 115100 ha<sup>-1</sup> with water hyacinth mulch. At the same time, the highest gross margin (Tk 69425 ha<sup>-1</sup>) was obtained from rice straw mulch. The no mulch treatment produced lowest gross return of Tk 70300 ha<sup>-1</sup> compared to all other treatments. The highest benefit cost ratio (2.51) was also obtained by rice straw mulch followed by water hyacinth (2.46), wastage of rice straw (2.08) and no mulch (1.69).

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