Original Research Article

EFFECT OF DIFFERENT TYPES OF MULCHES ONYIELD OF PUMPKIN IN SALT AFFECTED SOIL

ABSTRACT

In reducing soil salinity and obtaining a sustainable yield, a low-cost and farmer's friendly method is required for pumpkin, a well-liked vegetable. Accordingly, a field experiment was carried out in Salinity Management and Research Center, Soil Resource Development Institute, Batiaghata, Khulna during Kharif-1 season of 2021 to investigate the effect of different types of mulches on soil salinity and yield of pumpkin. The experiment includes three treatments viz. no mulch (control), straw mulch and mulching paper.The experiment was carried out in Randomized Complete Block Design with four replications.Soil salinity was recorded at 30 days intervals. All mulching materials effectively reduced the salt accumulation in the root zone. After three months of seed sowing,the highest soil salinity (11.32 dS/m) and lowest soil salinity (6.24 dS/m) were found at no mulch (control) and mulching paper treatment respectively in the month of May. Mulching treatments markedly increasedthe growth and yield attributes of pumpkins. The highest value of three growth parameters i.e., fruit length (26.92 cm), fruit diameter (94.09 cm) and fruit size (2037 cm^2) was found on mulching paper as compared to control. Again, the highest flesh thickness (3.94 cm), fruit weight (4.73 kg) and yield (31.18 t/ha) were recorded at mulching paper treatment whereas the lowest yield (16.68 t/ha) was found at no mulch (control). The results revealed that the use of mulching paper decreased salinity and also increased the yield of pumpkin in saline soil. These findings suggest that the application of mulching paper not only reduces soil salinity but also increases the yield of pumpkins.

Comment [AEN1]: Only single variable, and the experiment for one seasom??

Keywords:salinity;straw mulch; mulching paper; pumpkin; yield; sweet gourd.

1. INTRODUCTION

In Bangladesh, Pumpkin (*Cucurbitamoschata* Duchesne ex Poir.) or sweet gourd is a fairly common and well-liked vegetable. It is grown widely from homesteads to commercial fields and marketed all over the country. Due to its high vitamin A concentration, it is particularly healthy and can help to address the lack of vegetables and the nutritional issue. *Cucurbitamoschata* is medium-sized and widely grown in the tropics and subtropics, its fruit color is most often dark green, light yellow, or pale orange [1]. Pumpkin is a low-calorie vegetable that contains many anti-oxidants such as vitamin-A, vitamin-C and vitamin-E and dietary fiber [2]. At present, the total production of vegetables in Bangladesh is 3.73 million tonnes and per capita consumption is currently 62 gm a day against the Food and Agricultural Organization's (FAO) recommendation of 220 gm [3].

The foundation of Bangladesh's economy is agriculture which accounts for 12.65% of the country's GDP. Only 7% of the total cropped land in Bangladesh is used for horticulture crops, such as vegetables, while rice accounts for around 75% of the country's agricultural production. The area under vegetable cultivation accounts for only 2.56 percent of the total cropped areas [4]. In winter, a good number of vegetables are grown in Bangladesh among them pumpkin or sweet gourdis appreciated by consumers due to their widely usable nature. The Bangladeshi coastal region's agriculture is constantly under threat because of the

greater levels of soil and water salinity [5]. Both magnitude and levels of soil salinity have been increasing with time being 0.83, 1.02 and 1.06 mha in 1973, 2002 and 2009, respectively [6]. In comparison to floodplain agriculture, the average cropping intensity (%) in coastal areas has not increased at the same rate. In the coastal region, between 30 and 50 percent of net cultivated land is left fallow during the Rabi and Kharif-1 seasons. In such regions, intensive irrigation with light saline surface water exacerbated the issue since the evaporation of the large salt deposits left behind caused secondary salinization and alkalinization[7].

The salinity rises throughout the dry months, reaching a peak in April-May, and falls during the rainy months, reaching a minimum in July–August [8]. Polythene mulch is utilized extensively worldwide as a crucial farming strategy because of the enormous advantages it provides for increasing crop productivity and water conservation [9]. The use of polythene mulch may be able to lessen the amount and frequency of irrigation needed for maize production as well as the capillary rise and evaporation losses of water from the soil [10]. Additionally, it is said that mulching paper is a successful method for encouraging crop emergence because it alters the soil microclimate by raising soil temperature in the winter [10]. Mulching paper can hold precipitation, decrease water loss and increase the water use efficiency of crop plants. Although some research on using polythene mulch to stop soil erosion and conserve water have been documented[11], little is known about how mulch affects saline soil management for potential pumpkin production. It has been shown that the use of mulching paper increased different growth parameters like plant height, thenumber of leaves per plant, root and shoot fresh and dry weights to a greater extent in maize in salt-affected soil.Additionally, it has been found that the usage of polythene mulch in maize production reduced salinity levels [12].

Therefore, mulching could be an effective choice for reducing soil salinity along with increasing production in coastal areas. Organic mulches can reduce the effect of salt toxicity on plant growth or actively accelerate soil desalinization.Considering the above fact, this experiment is designed to find out the effect of different mulching on soil salinity and yield performance of sweet gourd.

2. MATERIAL AND METHODS

2.1 Study Site

Thisexperiment was conducted at Salinity Management and Research Centre (SMRC), Soil Resource Development Institute, Batiaghata, Khulna, Bangladesh during the Kharif-1 season of 2021.Geographically the study site was at 22°46´01.8´´N latitude and 89°24´15.2´´E longitude and under AEZ-13.With an average yearly temperature of79.3 °F and monthly mean temperatures ranging from54.3 °F in January to 93.7 °Fin May, the area is among the warmest in Bangladesh[13].

2.2 Experimental Layout and Crop Management

The experiment was carried out in Randomized Complete Block Design with fourreplications. Sweet gourd (variety- Bengal Sweet-2) was taken as an experimental crop. Three experimental treatments were considered viz. (a) control (no mulch) (b) straw mulch (c) mulching paper.The experiment plot was prepared by several ploughing and cross ploughing followed byladdering and harrowing with tractor and power tiller to bring about good tilth. Weeds and other stables were removed carefully from theexperimental plot and leveled properly.Manure and basal dose of fertilizer were applied during land preparation. Germinated seeds weresown and necessary intercultural operations were done when it necessary.The seeds were sownon 05-02-2021. Data were recorded as per requirement. Soil salinity was measured by using EC Meter at 30 days intervals. All the intercultural

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operations like watering, gap filling,staking, weeding, and plant protection measureswere executed carefully.

2.3 Measurement of Growth and Yield Characteristics

Five growth and yield parameters such as fruit length (cm), fruit diameter (cm), fruit size (cm^2), flesh thickness (cm) and fruit weight (kg) were taken under consideration to analyze the effect of mulches on yield of sweet gourd. Total yield (t/ha) was calculated by measuring total fruit weight of a plot.

2.4 Statistical Analysis

Thecollecteddataweretabulatedandstatistically analyzedusing Statistix 10 software. The treatmentmeans were separated statistically at5%levelofsignificanceusing Duncan's Multiple Range Test (DMRT).

3. RESULTS AND DISCUSSION

3.1 Effects of Different Mulches on Soil Salinity

Control of root zone salinity in saline fieldsis considered beneficial to seed emergence and stand establishment [14]. Previous studies have shown that mulching with different materials is a promising technique for salinity control in agriculture [15].An upward trend of soil salinity at all treatments was observed from February to May (Table 1).In the month of February, the lowest soil salinity was found at mulching paper (4.80 dS/m) while the highest soil salinity was observed at control (5.62 dS/m) where no mulch was used. Since soil salinity increases gradually from the month of February to May, the lowest salinity was found in the month of February (4.80 dS/m) as compared to the highest in the month of May (11.32 dS/m). In the month of May, the lowest soil salinity was found at mulching paper (6.24 dS/m) in comparison with the highest soil salinity found in control (11.32 dS/m) (Table 1). Thus, it revealed that soil salinity can be reduced by using different mulches in which mulching paper has a significant effect on reducing soil salinity.These results are emphasized by some authors who reported thatall mulching materials effectively reduced salt accumulation in the root zone [16].

Table 1: Effect of mulches on soil salinity of experimental plot during cultivation period

Treatment	Month-wise soil salinity (EC: dS/m)			
	Feb	Mar	April	May
Control	5.62	7.65	9.59	11.32
Straw Mulch	5.24	6.25	8.62	9.25
Mulching Paper	4.80	5.32	6.85	6.24

3.2 Effects of Different Mulches on Growth Characteristics of Pumpkincv.Bengal Sweet-2

Fruit length, fruit diameter and fruit size were statistically analyzed as shown in Table2. They showed a significant variationin relation to different mulch materials.The highest fruit length (26.92 cm) was found at mulching paper while the lowest (16.04 cm) was found at control where no mulch applied. The highest fruit diameter (94.09cm) and fruit size (2037cm^2) were observed at mulching paper in comparison with the control where the lowest fruit diameter (66.03 cm) and fruit size (1638 cm^2) were found (Table 2). Sageer Khan et al (2015) found

that fruit length (cm), fruit weight (g), fruit diameter (cm), no. of fruits per plant and fruit yield (213.47q/ha) of sponge gourd were significantly superior with black polyethylene mulch while, plants without mulch (control) resulted in poor growth and yield [17].TheseresultsareinconformitywithIslam et al (2021)who reported that yield characteristics like diameter of fruit,weight of fruit and fruits per vine showedsignificant results with blackpolyethylene mulch in case of different high-value vegetables in Bangladesh [18].A similar trend was also found in the findings of Yaseen et al (2014) whoreportedthatleafarea(LAI)andplantheightweresignificantlyaffectedbythemulchingtreatments [19].

Table 1: Effect of mulches on yield and yield contributing charactersof Pumpkin

Treatment	Fruit Length (cm)	Fruit diameter (cm)	Fruit size (cm^2)
Control	16.04c	66.03c	1638c
Straw Mulch	23.82b	82.98b	1816b
Mulching Paper	26.92a	94.09a	2037a
Level of sig.	**	**	**
CV (%)	6.80	4.19	3.33

Level of significance ** = 1%; * = 5%.

3.3 Effects of Different Mulches on Yield attributes of Pumpkin cv. Bengal Sweet-2

Flesh thickness, fruit weight and yield of sweet gourd grown under different mulching treatments are presented in Table 3. Statistical analysis was carried out on yield and yield attributes which revealed that these are significantly varied due to different mulches.Maximum flesh thickness (3.94 cm) was recorded in mulching paper which was statistically similar to straw mulch (3.79 cm). While minimum flesh thickness (2.93 cm) was observed in control. Again, the highest fruit weight (4.73 kg) was recorded in mulching paper followed by straw mulch (3.83 kg) whereas the lowest fruit weight (2.15 kg) was found in control treatment(Table 3). The researchers indicated that plants under polyethylene mulch produce larger fruit and have higher fruit yield per plant because of the better plant growth that due to a favorable hydro-thermal regime of soil and a complete weed-free environment.The data depicted that the highest yield (31.18 t/ha) was found at mulching paper while the lowest (16.68 t/ha) was found at control where no mulch was applied.By encouraging changes in the plant's microenvironment, plastic mulch enhances plant growth and vigor as well as production and yield.

Table 3: Effect of mulches on yield and yield contributing characters of Pumpkin

Treatment	Flesh thickness (cm)	Fruit weight (kg)	Yield (t/ha)
Control	2.93b	2.15c	16.68c
Straw Mulch	3.79a	3.83b	20.62b
Mulching Paper	3.94a	4.73a	31.18a
Level of sig.	*	**	**
CV (%)	4.93	7.02	9.32

Level of significance ** = 1%; * = 5%.Means havingsimilar letter(s) are statistically similar and those havingdifferent letter(s) differ significantly at 5% level.

A similar result was reported by Mahadeen (2014) who observed that polythene mulch resulted in higher yield in two summer vegetables compared to straw mulch and no mulch

[20]. This result may be due to the improvement of soil physical properties as well as increasing soil water holding capacity which gave rise to good aeration and drainage that encourage better root growth and nutrient absorption [20].This result isin the line withthoserecordedbyYongganet al (2016) who reported that the combined application of straw layer burial and plastic mulch performed better than either the individual use of straw layer or plastic mulch for controlling salt accumulation in the topsoil layerand increasing sunflower yield [21]. Akhter et al (2018) also reported that black polythenemulch and phosphorus at 90 kg P_2O_5/ha wouldbe suitable for optimum vegetative growth andyield of squash compare to other treatments [22].

4. CONCLUSION

It may be concluded from the experiment's findings that using mulching materials led to a noticeable decrease in the accumulation of salts. Maximum soil salinity was reduced by using mulching paper in comparison with the control treatment where no mulch was applied. The reduction of soil salinity followed the following order of treatment: mulching paper > straw mulch > control.Different growth and yield attributes were significantly varied due to different mulching treatments. Results implied that mulching paper treatment gave the highest yield (31.18 t/ha) followed by straw mulch treatment yielded 20.62 t/ha. Whereas, the lowest yield (16.68 t/ha) was recorded in control treatment.Between two types of mulch mulching paper can be used atthe farmer's level to reduce soil salinity and increase the yield of sweet gourd. However, further research is still needed to work out a cost-effective technology to reduce soil salinity and increase the yield of sweet gourds.

REFERENCES

1. KiramanaJK, Isutsa DK. First detailed morphological characterization of qualitative traits of extensive naturalized pumpkin germplasm in Kenya. International Journal of Development and Sustainability. 2017;6(7):500-525.

2. Yadav M, Jain S, Tomar R, Prasad GB, Yadav H. Medicinal and biological potential of pumpkin: An Updated Review. Nutrition Research Reviews. 2010;23(2):184–190.

3. Anonymous. Per capita deficiency of vegetables 158gm a day. The Financial Express. Accessed 26 August 2022. Available: https://rb.gy/t7rwbh.

4. BBS. Yearbook of Agricultural Statistics of Bangladesh, (33rd Series). Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh. 2021. Available: https://tinyurl.com/49c4dhda.

5. MoA and FAO. Master Plan for Agricultural Development in the Southern Region of Bangladesh. Ministry of Agriculture.2013;37-40.Available :https://www.fao.org/3/au752e/au752e.pdf.

6. Fertilizer Recommendation Guide (FRG). Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka. 2012;66.

7. Roychoudhury A, Chakraborty M. Biochemical and molecular basis of varietal difference in plant salt tolerance. Annual Review & Research in Biology. 2013;3(4):422-454.

8. Haque MA, Jahiruddin M, Hoque MA, Rahman MZ, Clarke D. Temporal variability of soil and water salinity and its effect on crop at Kalaparaupazila. Journal of Environmental Science & Natural Resources. 2014;7(2):111-114.

9. Sun SJ, Fan YM, XuZH, Zhang XD, Chi DC. Effects of planting density on soil moisture and corn yield under plastic film mulching in a rain-fed region of northeast China. Chinese Journal of Ecology. 2014;33:2650– 2655.Chinese.

10. Bu L, Liu J, Zhu L, Luo S, Chen X, Li SQ. The effects of mulching on maize growth, yield and water use in a semi-arid region. Agriculture Water Management. 2013;123:71–78.

11. Zhang G, Zhang X, Hu X. Runoff and soil erosion as affected by plastic mulch patterns in vegetable field at Dianchilake's catchment, China. Agricultural Water Management. 2013;122: 20-27.

12. Sikder MU, Haque MA, Jodder R, Kumar T, Mondal D. Polythene Mulch and Irrigation for Mitigation of Salinity Effects on Maize (*Zea mays* L.). The Agriculturists. 2016;14(2):1-13.

13. Anonymous. Bangladesh agro-meteorological information portal. Department of Agricultural Extension. Accessed 26 August 2022. Available: https://www.bamis.gov.bd/en/page/aezs-maps/.

14. Dong H, Li W, Xin C, Tang W, Zhang D. Late planting of short-season cotton in saline fields of the Yellow River Delta. Crop Sci. 2010;50:292–300.

15. Pang H, Li Y, Yang J, Liang Y. Effect of brackish water irrigation and straw mulching soil salinity and crop yields under monsoonal climatic conditions. Agric. Water Manag. 2010;97:1971-1977.

16. Taia A. Abd El-Mageed, Wael M. Semida, Mohamed H. Abd El-Wahed. Effect of mulching on plant water status, soil salinity and yield of squash under summer-fall deficit irrigation in salt affected soil. Agricultural Water Management. 2016;173(C):1-12.https://doi.org/10.1016/j.agwat.2016.04.025.

17. Khan S, Pal M, Kumar V. Influence of different mulches on growth and yield of sponge gourd (*Luffacylindrica* L.). Plant Archives. 2015; 15(1): 393-395.

18. Islam F, Quamruzzaman A, Mallick SR.Effect of different mulch paper on growthand yield of different high value vegetables in Bangladesh. Agricultural Sciences. 2021;12:237-246.DOI: https://doi.org/10.4236/as.2021.123015.

19. Yaseen R, Shafi J, Ahmad W, Rana MS, Salim M, Qaisrani SA. Effect of Deficit Irrigation and Mulch on Soil Physical Properties, Growth and Yield of Maize. Environment and Ecology Research. 2014;2(3):122-137. DOI:10.13189/eer.2014.020302.

20. Mahadeen AY. Effect of polyethylene black plastic mulch on growth and yield of two summer vegetable crops under rain-feed conditions under semi-arid region conditions. American Journal of Agricultural Biological Sciences. 2014;9(2):202-207.

21. Yonggan Z, Yuyi L, Jing W, Huancheng P, Yan L. Buried straw layer plus plastic mulching reduces soil salinity and increases sunflower yield in saline soils. Soil and Tillage Research. 2016;155: 363-370. DOI:10.1016/j.still.2015.08.019.

22. AkhterF,MostarinT, IslamMN, AkhterS.Effect ofMulches and Phosphorus on Growth and Yield of Squash (*Cucurbitapepo*). The Agriculturists.2018;16:25-34. DOI: 10.3329/agric.v16i02.40340.