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Effect of Mulching on Growth and Yield of Potato Crop

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Abstract: Field experiments to study the effect of mulching on growth and yield of potato crop were conducted for three years (1998, 1999 and 2000) at NARC, Islamabad. Mulching has very positive effect on emergence. In all the trials, it was maximum in T_1. After 35 days of planting, highest emergence was 78.5% in T_1, 84.25% in T_2 and 83.25% in T_1 during spring 1998, 1999 and 2000 respectively. After 45 DAP (days after planting), during 1998, 1999 and 2000, highest emergence was 97.67% in T_1 , 100% in T_2 and 98.75% in T_1, respectively. In the trials lowest emergence was recorded in T_5 (control). Growth rate was also better in all treatments where mulching was applied as compared to control at 45 and 60 DAP. In the year 1998, at 60 DAP, maximum growth rate (64%) was recorded in T_1, followed by 53.67% in T_2 and lowest (36.67%) in T_5. In 1999 trial, maximum growth rate (46.5%) was noted in T_2, followed by 43% in T_4 and minimum (30.25%) in T_5. In 2000 trial also highest growth (49%) was recorded in T_1 followed by 45.25% in T_2 and lowest (31.75%) in T_5. Similarly, at 75 DAP, all treatments where mulching was applied were found significantly different than control at 75 DAP. Mulching has also a significant effect on yield of potato crop. In the treatments where mulching was done with plastic sheet (black or white), yield was more than 17 t/ha (T_1, T_2 and T_3). In T_4 where grass mulch was applied, yield was 16.44 t/ha. However, highest yield (18.42 t/ha) was recorded in T_1, followed by 17.6, 17.11 and 16.44 t/ha in T_2, T_3 and T_4, respectively. Lowest yield (11.48 t/ha) was obtained in T_5. Overall increase in yield was 60.45% in T_1, 49.04% in T_2, 53.31% in T_3 and 43.2% in T_4 over T_5.

Key words: Mulching effect, growth, yield, potato, *Solanum tuberosum*

Introduction

In some parts of irrigated plans, two potato crops are raised, i.e., spring and autumn. The spring crop is planted in the month of January when temperature is low. This low temperature delays emergence while during crop development temperature starts rising day by day which affect crop production period adversely. To get better yield it is necessary to provide sufficient time period to this crop. This can be achieved by getting rapid germination. Studies were undertaken to get quicker emergence and more yield by using different types of mulching. Coling (1997) reported that plastic film mulches increased plant height, leaf area index, dry matter accumulation and tuber yield of potatoes. The percentage of large and medium sized tubers were also more. Sarma *et al.* (1999) planted potato cv. Kufrimegha on ridges or flat seedbeds in various combinations with mulching and earthing up and reported that mulching with black plastic film increased the tuber yield significantly over normal planting method. Plastic mulch conserved soil moisture and helped in better crop growth and tuber yield. Using two close rows (25 cm) on flat seedbeds and mulching gave highest additional return over normal planting per rupee invested in mulch while 50% mulch cover either on ridges or flat beds gave higher net return. Jaiswal (1995) conducted a field experiment during three consecutive years (1990-92) to develop agronomic practices for raising early crop of potato (*Solanum tuberosum*) in warm temperature condition and reported that crop planted on 25 September gave 27 and 19% more yield than crop planted on 15 September, respectively.

All cultivars (kufri Chandramukhi, Kufri Jyoti and JH 222) gave the highest tuber yield when planted on 25 September. Among the cultivars, Kufri Chandramukhi gave the highest yield followed by Kufri Jyoti. On an average, mulching increased tuber yield by 25% over no mulch, However, the increases due to mulching was 58 and 46% in crops planted on 05 and 15 September respectively. Mulching decreased daily maximum soil temperature at 15 cm depth by 1.5 – 4.5 °C resulting in faster emergence, early canopy development and higher tuber yield. Mulching also effectively controlled weed growth. Weed dry weight reduced substantially with delayed planting.

Materials and Methods

Field experiments were conducted for three years (1998, 1999 and 2000) at NARC, Islamabad during spring season with the following treatments.

T_1 Mulching with white polythene sheet.
T_2 Mulching with black polythene sheet.
T_3 Mulching with perforated black polythene sheet.
T_4 Mulching with grasses.
T_5 Control - no mulching.

The trial was planted in Randomized Complete Block Design (RCBD). Seed of variety, Cardinal were used for planting in plots (4 x 3 m^2) with spacing of 20 cm. 125 kg N, 125 Kg P and 125 Kg K as basal and 125 Kg N was top dressed at the time of earthing up. 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. Uniyal *et al.* (1994) used five mulching materials, i.e., wheat straw, green twigs of non fodder plant species, farm yard manure, pine needles and frost litter were tried along with control (without mulch) in four replications, in randomized complete block design (RCBD). Different mulching materials were applied immediately after planting @ 600 q ha^{-1} of farm yard manure, 150 q ha^{-1} of frost litter and wheat straw, 166 q ha^{-1} of pine needles and 20 q ha^{-1} of green twigs. After 45 days of planting, the mulches were removed and reapplied immediately after the completion of earthing and top dressing of N. The crop was harvested in the month of May. Data on Emergence %age, growth rate (%), stems per plant and tuber yield was recorded (Table 1 and 2) and was analyzed statistically through variance (based on randomized complete block design) and correlation was calculated using MSTAT micro computer programme, version 4.0 (Freed *et al.*, 1987).

Results and Discussion

Mulching has very positive effect on emergence. In all the trials it was maximum in T_1. After 35 days of planting, highest emergence was 78.5% in T_1, 84.25% in T_2 and 83.25% in T_1 during spring 1998, 1999 and 2000, respectively (Table 1). After 45 DAP, during 1998, 1999 and 2000, highest emergence was 97.67% in T_1, 100% in T_2 and 98.75% in T_1, respectively. In the trials lowest emergence was recorded in T_5 (control) (Table 1). This reflects how much mulching can accelerate emergence. Wierzbicka (1995) also reported that mulching increased emergence by 5 days. The combination of pre-sprouting and mulching was most profitable. These results are also correlated with the findings of Ping *et al.* (1994). They reported that mulching the ridges increased the soil temperature, improved the soil characteristics and improved early plant growth. This lead to earlier maturity and higher tuber yield.

Growth rate was also better and huger in all treatments where mulching was applied as compared to control at 60 and 75 DAP (Table 2). During 1998, 1999 and 2000 trials, highest growth rate was recorded in T_1 followed by T_2. In the year 1998, at 60 DAP, maximum growth rate (64%) was recorded in T_1, followed by 53.67% in T_2 and lowest (36.67%) in T_5. In 1999 trial, maximum growth rate (46.5%) was noted in T_2, followed by 43% in T_4 and minimum (30.25%) in T_5. In 2000 trial also highest growth (49%) was recorded in T_1 followed by 45.25% in T_2 and lowest (31.75%) in T_5 (Table 2). Similarly, at 75 DAP, T_1 and T_2 were found significantly different than other treatments. However, all treatments where mulching was applied were found significantly different than control at 75 DAP. Mulching has significant effect on yield of potato crop. In the treatments where mulching was done with plastic sheet (black or white), yield was more than 17 t ha^{-1} (T_1, T_2 and T_3). In T_4 where grass mulch was applied, yield was 16.44 t ha^{-1} (Table 3). However, highest yield (18.42 t ha^{-1}) was recorded in the treatments where white plastic sheet was applied, followed by 17.6, 17.11 and 16.44 t ha^{-1} in T_1, T_2, T_3 and T_4, respectively (Table 3). Lowest yield (11.48 t ha^{-1}) was obtained in T_5. Overall increase in yield was 60.45% in T_1, 49.04% in T_2, 53.31% in T_3 and 43.2% in T_4 over T_5 (Table 3). These results are also supported by the findings of Khalak and Kumaraswary (1993). They reported that tuber yield was increased from 14.3 t ha^{-1} with no mulching to 16.7 t ha^{-1} with straw and 18.2 t ha^{-1} with plastic mulches. They also pointed out that mulching with straw was superior to plastic in terms of incremental cost

Table 1: Effect of mulching on emergence.

	1998		1999		2000	
Treatments	60 DAP	75 DAP	60 DAP	75 DAP	60 DAP	75 DAP
Mulching with white polythene sheet (T_1)	78.50	97.67	84	98.25	83.25	98.75
Mulching with black polythene sheet (T_2)	52.90	96.33	84.25	100	77.25	97.75
Mulching with perforated black polythene sheet (T_3)	39.40	95.67	79.50	99	98.5	97
Mulching with grasses (T_4)	16.50	95.67	61.75	97	64.5	95
Control (T_5)	8.16	90.33	4	68	6.25	83.5
LSD	19.22	6.77	13.99	9.685	9.862	2.612

Table 2: Effect of mulching on growth rate (%).

	1998		1999		2000	
Treatments	60 DAP	75 DAP	60 DA	75 DAP	60 DAP	75 DAP
Mulching with white polythene sheet (T_1)	64	73	36	80	49	78.5
Mulching with black polythene sheet (T_2)	53.67	62.33	46.5	77.75	45.25	75.5
Mulching with perforated black polythene sheet (T_3)	46	59	37	66.25	44.75	74.75
Mulching with grasses (T_4)	39.33	60.33	43	60.25	45	75
Control (T_5)	36.67	60	30.25	44.25	31.75	63.75
LSD	5.27	6.348	13.53	9.957	5.942	6.138

Table 3: Effect of mulching on yield.

	Yield (t ha^{-1})					
Treatments	1998	1999	2000	Mean	Difference t ha^{-1})	% increase in yield
Mulching with white polythene sheet (T_1)	18.78	18.54	17.93	18.42	6.94	60.45
Mulching with black polythene sheet (T_2)	16.16	18.68	16.48	17.11	5.63	49.04
Mulching with perforated black polythene sheet (T_3)	17.83	18.06	16.91	17.6	6.12	53.31
Mulching with grasses (T_4)	17.39	16.2	15.73	16.44	4.96	43.20
Control (T_5)	14.94	8.5	11	11.48	-	-
LSD	4.196	2.744	1.372	-	-	-

Table 4: Economic analysis of the trial.

Treatments	T_1	T_2	T3	T_4	T_5
Average yield (kg ha^{-1})	184200.00	17110.00	17600.00	16440.00	11480.0
Field price of produce (Rs./Kg)	4.50	4.50	4.50	4.50	4.50
Field Gross benefit (1)	82890.00	76995.00	79200.00	79200.00	73980.00
Cost that var (C.V) (2)	9500.00	9500.00	9500.00	9500.00	3750.00
Net benefit 3 = 1-2	73390.00	6745.00	69700.00	69700.00	70230.00
MROR(%)	228.70	Dominated	Dominated	495.2	54.95

1- Prices of inputs, I. Straw = Rs. 375 / tonne, II. Polythene sheet = Rs. 70 / Kg, III. Potato tubers = Rs. 450 / Kg, 2 – Economic life of polythene is 3 seasons.
3- Residues of paddy straw left will add organic matter status apart from improving, physico- chemical properties of soil.

benefit ratios. In a field study in 1994-95 near Sisevac, Yugoslavia, potato, cv. Desiree were grown with or without application of 5 t ha^{-1} of organic mulch (air-dried material from natural meadows). Mulch application resulted in a significant decrease in soil temperature in the root zone and the conservation of soil moisture. The number and weight of tubers and tuber yield in the mulch treatment were significantly greater in both years than on plots without mulch (Momirovic *et al.*, 1997). Ruiz *et al.* (1999) mulched potatoes cv. Spunta by transparent, white or black, polythylene of 25 um thickness, or co-extracted black and white plastic of 50 um thickness in a field experiment in 1993-95 in Granada, Spain and reported that the use of white and black- and – white plastic promoted optimum root temperature for plant growth (23-27 °C) and resulted in the greatest efficiency of nitrogen utilization and the greatest tuber yield. Highest root temperature caused by black plastic (>31 °C) depressed nitrogen metabolism as well as yield. Transparent plastic caused more damage than did the absence of mulch. From the results it is concluded that mulching has very good effect on emergence. Plastic sheet enhances temperature and accelerates the germination. More weeds were observed where white plastic sheet was used as compared to black plastic sheet. However, no remarkable effect of mulching types was observed on yield. Tuber yield obtained was significantly superior in polythene mulches as a result of its influence on temperature. When cost of mulching was considered, straw mulch was better than polythene mulches (Table 4). Similar results were also reported by Sand Singh (1974) and Sood and Sharma (1985) that in terms of economic benefit paddy straw mulch was beneficial over polythene mulch as the incremental cost benefit ratio (ICBR) was higher with straw mulches (1:4:1) when compared to polythene (1:1:3). Further the residues of paddy straw will add to the organic matter status apart from improving physico-chemical properties of soil.

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