Growth, Yield attributes and economics of potato as influenced by different planting dates and various mulching practices

ABSTRACT

The present research work was conducted at Pili kothi farm, Department of Agronomy, TilakDhari Post Graduate College, Jaunpur, Uttar Pradesh during winter season of 2018 and 2019. The experiment was laid out in Factorial Randomized Block Design. The treatments comprised of different planting dates viz.20 days early planting on 17th October, 10 days early planting on 27th October, Optimum planting time on 7th November, 10 days late planting on 17th November and 20 days late planting on 27th November and different mulching practices viz.Organic mulch (Paddy straw at 5 t/ha), Plastic mulch (Black colour) and Control (Without mulch) of potato. There were 15 treatments and each were replicated to fourfolds. These treatments were randomly arranged in each replication and divided into sixty plots. The results revealed that the significantly maximum number of haulms/hill at 45 DAT (4.50, 4.70 and 4.60),plant height (52.30, 54.00 and 53.10 cm), dry weight/plant At 60 DAP (27.90, 28.20 and 28.00), weight of tubers/plant (496.40, 504.10 and 500.30), weight of tubers/plant (>75 g) (207.70, 209.00 and 208.30) and tuber yield (369.30, 370.70 and 370.00 q/ha) were recorded under 20 Days Early Planting On 17th October among different planting dates during first, second and mean data also. Whereas among the mulching practices significant variation were recorded among the all parameter. However maximum number of haulms/hill at 45 DAT (3.60, 3.70 and 3.70), plant height (50.20, 52.0 and 51.10 cm), dry weight/plant At 60 DAP (25.5, 25.9 and 25.7), weight of tubers/plant (454.80, 460.70 and 457.70), weight of tubers/plant (>75 g) (191.90, 193.30 and 192.60) and tuber yield (333.80, 334.90 and 334.30 q/ha) under the organic mulch (paddy straw at 5 t/ha) respectively, during first, second as well as in mean data also.

Keywords : Dates of planting, Mulching, Potato, Growth attributes, yield attributes and economics.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is the third most important food crop in consumption in the world after rice and wheat **(Hancock *et al.*, 2014).**The higher profit from the potato crop under rice fallows not only depends on the management practices, but it also depends on soil moisture content and temperature conditions. Because potato crop is very sensitive to lack of soil moisture and temperature which affects the growth and developmental process, and finally leads to higher and lower tuber yield.The optimum date of planting for potato is highly location-specific and every production region has an 'optimum' planting period during which conditions are most favourable for giving the higher yield**(Satapathy *et al.* 2016)**. Mulching improved seedling emergence, plant height and numbers of stems **(Singh and Ahmed, 2008).**Potato is grown during the winter season when rainfall is scarce and irrigation become essential for providing sufficient moisture to the growing crop. To

minimize the cultivation cost mulching could be effectively used instead of irrigation. Mulching is one of the important agronomic practice beneficial in conserving the soil moisture, suppressing the weeds, improving soil fertility**Puloke*t al.* (2016).**. Organic mulch are efficient in reduction of nitrates leaching, improve soil physical properties, prevent erosion, supply organic matter, regulate temperature and water retention, improve nitrogen balance, take part in nutrient cycle as well as increase the biological activity**Bhardwaj.,(2013).**Mulching had significant influence on potato growth and yield.Considering this, an attempt was made to find out the suitable planting date of potato with mulching for higher productivity.

MATERIALS METHODS

A field experiment entitled was conducted at crop research farm (Pilikothi) of Agronomy Department, TilakDhari Post Graduate College, Jaunpur (U.P.) during *rabi*season of 2018-19and 2019-20..There were 15 treatments and each were replicated to four folds. These treatments were randomly arranged in each replication and divided into sixty plots.The gross plot size was 5 m× 3 m (15 m^2). The pre-sowing irrigation was done after the harvest of the preceding crop. The whole experimental field was irrigated and left for four days. So that the rhizosphere attain moisture and good soil structure. For getting good condition of field ploughing was done along with planking in each ploughing, which helps in breaking the clods and levelling the land for proper seedbed. Previous crop residues or stubbles and weeds were removed with the help of rake and also partial work done manually by hand. The row to row and plant to plant seed potatoes were planted in each unit plot maintaining a spacing of 60 cm × 20 cm.The fertilizer inputs used are urea as a source of nitrogen, diammonium phosphate (DAP) as a source of phosphorus, muriate of potash (MOP) as a source of potassium. 120 kg N, 60 kg P_2O_5 and 80 kg K_2O/ha are used as recommended dose of fertilizers during the experiment and fertilizer requirement calculated individually on the basis of each plot. Height of the five randomly selected plants was measured with the help of meter scale from soil surface to the apical bund at 60 days after planting and the mean values were taken in cm. Five selected plants were taken for fresh weight at the time of haulm cutting. For dry weight they were firstly dried in an oven at 60^0C temperature. After complete drying, average weight of plant (g) was weighed by electronic balance.

RESULT AND DISCUSSION

Number of haulms/hill at 45 DAP

The data pertaining to number of haulms/hill as influenced by different dates of planting and mulching were presented in Table1. The data on the number of haulms at 45 DAP as influenced by different planting dates and mulching showed significant difference.However, potato planted on 20 days early planting on 17 October recorded significantly higher (4.50, 4.70 and 4.60)number of haulms/hill at 45 DAT and none of the treatments found statistically at par value during first, second as well as in mean data also. The data on mulches shown that significantly higher number of haulms at 45 DAP was recorded in Organic mulch (Paddy straw at 5 t/ha) (3.60, 3.70 and 3.70) during all experimental years which was followed by Plastic mulch (Black colour) (3.40 and 3.50) during first year and second year except mean data.That may be attributed to rising soil temperature and conservation of more moisture in the black polythene covered soil that accelerated the germination and emergence of potato. Besides, mulching provides favourable physio-chemical conditions of soil like good soil aeration, porosity, water holding capacity, better availability of nutrients. Similar research finding also reported by Zahed *et al*. (2021).

Plant height (cm) at 60 DAP

At 60 DAP, 20 days early planting on 17th October recorded significantly higher plant height (52.30, 54.00 and 53.10 cm) in 2018, 2019 and in mean data, respectively. None of the at par findings was reported at this stage.At 60 DAP, same trend was followed in all of the treatments following mulching practices in all the years. Organic mulch (Paddy straw at 5 t/ha) performed significantly maximum plant height (50.20, 52.0 and 51.10 cm) in all of the experimental years. Similarly, at par values lead to the Plastic mulch (Black colour) plots (49.60, 51.40 and 50.50 cm), respectively.This might be high moisture regime due to irrigationunder this treatment which facilitated better waterand nutrient uptake by the plants. Application of mulch also significantly produced better plant growthas compared to non mulch condition.**Begum and Saikia (2014)**. Early planting resulted in tallest plant as during this stage, air temperature was maximum as compared to rest of the sowing dates.**Ilyas and Ayub (2017).**

Dry weight/plant at 60 DAP

At 60 DAT, data analysed shown significant difference among all treatments of different dates of planting. In first year (2018), second year (2019) and in mean analysis, 20 days early planting on 17th October recorded significantly higher dry weight/plant (27.90, 28.20 and 28.00) and there

was no at par values reported.Whereas, significantly higher dry weight/plant was obtained in Organic mulch (Paddy straw at 5 t/ha) treated plot (25.5, 25.9 and 25.7) and at par values are reported in Plastic mulch (Black colour) treated plot (25.0, 25.4 and 25.2), respectively.The growth duration was shortened due to delay inplanting date, hence, dry matter accumulation, tuber freshweight and final yield were all decreased because ofinsufficient cumulative temperature over the shortergrowing periods Similar findings also observed by **Gogoi and Ray (2019).**The increase in dry matter can be attributed to the fact that atearlier stages, most of the dry matter was concentrated inleaf and stem and from tuber initiation to tuberdevelopment it accumulated in stolon.Higher interception of solar radiation in earlier sowing may be responsible for more dry matter accumulation plant-1 when soil moisture and light are non limiting, higher temperatures accelerate growth process.**Vishwas *et al*. (2020).**

Weight of tubers/plant (g)

The data regarding weight of tubers per plant represented significant difference among all the treatments of different dates of planting. In first year, second year and in mean analysis, 20 days early planting on 17th October recorded significantly higher weight of tubers/plant (496.40, 504.10 and 500.30) and there was no at par values recorded among the treatments.Among various mulching practices, significantly higher weight of tubers/plant was recorded in Organic mulch (Paddy straw at 5 t/ha) treated plot (454.80, 460.70 and 457.70) and none of treatments foundat par values.The enhanced nutrient availability andmicrobial activity in mulch conditions especially inearly growing stage helps in more number of stolonformation and the increased nutrient uptake lead to thebetter development that leads to improved size andweight of tubers. The above results are in accordancewith the findings.**Zahed *et al*.(2021).**

Weight of tubers/plant (>75 g)

Weight of tubers/plant (>75 g) of potato significantly influenced due to different dates of planting and different mulching practices. Among different dates of planting significantly higher weight of tubers/plant (>75 g) (207.70, 209.00 and 208.30) was found in 20 days early planting on 17th October and none of the treatments found statistically at par value during all the years.Regarding mulches, significantly maximum weight of tubers/plant (>75 g) (191.90, 193.30 and 192.60) was recorded under Organic mulch (Paddy straw at 5 t/ha) which was at par with Plastic mulch (Black colour) (189.60, 191.00 and 190.30) during both the years of experimentation and also among mean data.

Total tuber yield (q/ha)

The data pertaining to number of haulms/hill as influenced by different dates of planting and mulching were presented in Table 2. Dates of planting represented statistically significant difference among various treatments. Significantly higher tuber yield (369.30, 370.70 and 370.00 q/ha) of potato was recorded under 20 days early planting on 17th October treated plot during the experiment in all of the years, which was significantly superior over rest of the treatments.Among various mulching practices, significantly maximum tuber yield was recorded in Organic mulch (333.80, 334.90 and 334.30 q/ha) incorporated plot and no at pat values was noticed.

The early planted crop get warmertemperature during its vegetative growth and coolertemperature during its tuber development stage. Thisclimatic suitability increases the tuber yield of potato.Subsequently late planted potato caught underunfavourable climatic conditions hence the tuber yield decreases**. Similar results also reported byMalunjkar and Solanke (2007).**The straw mulch used after planting was the best mulching material for reaching the highest yield. **Petr *et al*. (2010).**The maximum tuber yield in 10 October sown crop due to optimum moisture and temperature condition along with good growth of plant which were not prevailing during late sown crop also observedby **(Haile *et al*., 2015)**,**Thongam*et al*., (2017)** and**Navneet *et al*., (2020).**This might be due to differencein physiological age of the seed tuber used for planting.**Satapathy *et al*. (2016).**Mulching also resulted in higher tuber yield in all the yield categories over no mulching. Such beneficial effects of mulching have been demonstrated in the results achieved by**Bijetaand Raghav.(2019).**Potato is reported to increase tuber yield when plants are mulched with plastics and straw mulch compared with plants grown in bare soil.**Bharat and Kumar (2021).** Total number oftubers decreased with delayed planting ascompared to the optimum date of planting. Theresults confirm the findings of **Singh *et al*.(2022).**

Cost of cultivation (Rs./ha)

Among the treatment combinations, cost of cultivation was recorded highest in the treatment of 20 days early planting on 17th October with Plastic mulch (Black colour) (Rs. 1,02,546.00/ha) found similar in all of the years. While, least was accounted in the treatment where 20 days early planting was done on 17th October + Control (Without mulch) (Rs.73,596.00/ha), respectively in both the years.

Mulching with paddy straw recorded increment in netreturns, benefit: cost ratio, economic efficiency and production efficiency over no mulch. Similar results also reported by**Satapathy *et al*. (2016).**

Gross returns(Rs./ha)

The data pertaining to gross returns revealed that mulching with paddy straw and early date of planting (17th October) fetched maximum gross returns (Rs.2,98,600.00, 2,98,800.00 and 2,98,700.00/ha) during both the years and in mean as compared to rest of the treatments. However, 20 days late planting of potato on 27th November without mulch obtained lowest readings (Rs. 2,21,600.00, 2,23,400.00 and 2,22,500.00/ha).

Net returns(Rs./ha)

A cursory glance showed that net returns recorded maximum of Rs. 2,23,554.00, 2,23,754.00 and 2,23,654.00/ha) were accrued with the application of Organic mulch (Paddy straw at 5 t/ha) and 20 days early planting on 17th Octoberduring first year, second year and in mean data. Where treatment combination of 20 days late planting on 27th November + Plastic mulch (Black colour) obtained least net returns of Rs. 1,21,054.00/ha (first year), Rs. 1,22,654.00/ha (second year) and Rs. 1,21,854.00/ha(mean of two years), respectively.

B:Cratio

As the gross returns and net returnswere high benefit cost analysis are also high. However, treatment combination of 20 days early planting on 17th October + Organic mulch (Paddy straw at 5 t/ha) recorded highest B:C ratio (2.98) similar in all the years. Whereas, 20 days late planting on 27th November + Plastic mulch (Black colour) treatment received less benefit cost ratio (1.18, 1.20 and 1.19).

CONCLUSION

From the present study it can be concluded that 17th October is the optimum planting time along with mulching with 5 ton/ha paddy straw was useful in enhancing the growth and yield as well as economics of potato crop.

Table : 1. Effect Of Different dates of planting and Different mulches on Growth attributes of Potato

Treatments	Number of haulms/hill at 45 DAP			Plant height (cm) at 60 DAP			Dry weight/plant at 60 DAP		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Date Of Planting (Factor : A)									
20 Days Early Planting On 17th October	4.50	4.70	4.60	52.30	54.00	53.10	27.90	28.20	28.00
10 Days Early Planting On 27th October	3.80	4.10	3.90	50.60	51.80	51.20	26.70	27.00	26.80
Optimum Planting Time On 7th November	3.20	3.30	3.30	49.70	51.40	50.50	24.50	24.90	24.70
10 Days Late Planting On 17th November	2.90	3.00	2.90	48.80	50.70	49.80	23.60	23.80	23.70
20 Days Late Planting On 27th November	2.40	2.50	2.50	47.00	48.60	47.80	22.90	23.20	23.10
F test	S	S	S	S	S	S	S	S	S
SE(m)±	0.14	0.15	0.14	0.38	0.42	0.36	0.22	0.27	0.24
CD (p=0.05)	0.41	0.43	0.40	1.10	1.21	1.03	0.64	0.76	0.68
Different Mulches (Factor : B)									
Organic Mulch (Paddy Straw at 5 t/ha)	3.60	3.70	3.70	50.20	52.0	51.10	25.5	25.9	25.7
Plastic Mulch (Black Colour)	3.40	3.50	3.40	49.60	51.40	50.50	25.0	25.4	25.2
Control (Without Mulch)	3.20	3.30	3.20	49.30	50.40	49.80	24.8	25.1	24.9
F test	S	S	S	S	S	S	S	S	S
SE(m)±	0.11	0.12	0.11	0.73	0.32	0.26	0.17	0.21	0.18
CD (p=0.05)	0.32	0.33	0.31	0.23	0.93	0.76	0.50	0.59	0.53

Table :2 . Effect Of Different dates of planting and Different mulches on Yield Attributes of Potato

Treatments	Weight of tubers/plant (g)			Weight of tubers/plant (>75 g)			Total tuber yield (q/ha)		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Date Of Planting (Factor : A)									
20 Days Early Planting On 17th October	496.40	504.10	500.30	207.70	209.00	208.30	369.30	370.70	370.00
10 Days Early Planting On 27th October	475.30	483.30	479.30	200.30	201.90	201.10	355.90	357.60	356.80
Optimum Planting Time On 7th November	449.40	456.10	452.80	189.70	191.10	190.40	333.10	334.10	333.60
10 Days Late Planting On 17th November	420.00	427.80	423.90	178.80	180.60	179.70	305.30	307.40	306.40
20 Days Late Planting On 27th November	385.60	390.80	388.20	166.30	167.70	167.00	280.50	282.40	281.50
F test	S	S	S	S	S	S	S	S	S
SE(m)±	2.35	2.07	2.11	1.39	1.20	1.27	1.33	1.17	1.23
CD (p=0.05)	6.73	5.94	6.05	3.98	3.44	3.65	3.81	3.35	3.52
Different Mulches(Factor : B)									
Organic Mulch (Paddy Straw at 5 t/ha)	454.80	460.70	457.70	191.90	193.30	192.60	333.80	334.90	334.30
Plastic Mulch (Black Colour)	445.80	453.60	449.70	189.60	191.00	190.30	328.80	330.50	329.60
Control (Without Mulch)	435.60	442.90	439.20	184.30	185.90	185.10	324.00	326.00	325.00
F test	S	S	S	S	S	S	S	S	S
SE(m)±	1.82	1.61	1.64	1.08	0.93	0.99	1.03	0.91	0.95
CD (p=0.05)	5.21	4.60	4.69	3.08	2.66	2.82	2.95	2.60	2.72

Table 3 :Effect of dates of planting and different mulching on economics in potato (*Rabi* season of 2018-19)

Treatments	Economics			
	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
20 days early planting on 17th October + Organic mulch (Paddy straw at 5 t/ha)	75,046.00	2,98,600.00	2,23,554.00	2.98
20 days early planting on 17th October + Plastic mulch (Black colour)	1,02,546.00	2,95,400.00	1,92,854.00	1.88
20 days early planting on 17th October + Control (Without mulch)	73,596.00	2,92,400.00	2,18,804.00	2.97
10 days early planting on 27th October + Organic mulch (Paddy straw at 5 t/ha)	75,046.00	2,88,200.00	2,13,154.00	2.84
10 days early planting on 27th October + Plastic mulch (Black colour)	1,02,546.00	2,85,200.00	1,82,654.00	1.78
10 days early planting on 27th October + Control (Without mulch)	73,596.00	2,80,800.00	2,07,204.00	2.82
Optimum planting time on 7th November + Organic mulch (Paddy straw at 5 t/ha)	75,046.00	2,70,600.00	1,95,554.00	2.61
Optimum planting time on 7th November + Plastic mulch (Black colour)	1,02,546.00	2,67,000.00	1,64,454.00	1.60
Optimum planting time on 7th November + Control (Without mulch)	73,596.00	2,61,800.00	1,88,204.00	2.56
10 days late planting on 17th November + Organic mulch (Paddy straw at 5 t/ha)	75,046.00	2,49,600.00	1,74,554.00	2.33
10 days late planting on 17th November + Plastic mulch (Black colour)	1,02,546.00	2,44,000.00	1,41,454.00	1.38
10 days late planting on 17th November + Control (Without mulch)	73,596.00	2,39,200.00	1,65,604.00	2.25
20 days late planting on 27th November + Organic mulch (Paddy straw at 5 t/ha)	75,046.00	2,28,000.00	1,52,954.00	2.04
20 days late planting on 27th November + Plastic mulch (Black colour)	1,02,546.00	2,23,600.00	1,21,054.00	1.18

20 days late planting on 27th November + Control (Without mulch)	73,596.00	2,21,600.00	1,48,004.00	2.01

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