EFFECT OF ZERO TILLAGE PRACTICES ON GROWTH AND YIELD OF POTATO

Comment [p1]: I recommend improving the title as it does not represent the results correctly, "THE EFFECT OF ALTERNATIVE TILLAGE PRACTICES ON POTATO GROWTH AND YIELD" I believe it is more appropriate

ABSTRACT

Comment [p2]: I recommend a briefer description of the variants studied (as listed in the table) and the summary presentation of some obtained values

An experiment was conducted during the *rabi* seasons of 2021-22 and 2022-23 at the Research Farm, ICAR-Central Potato Research Station RS, Gwalior (M.P.). The experiment consisted of 7 treatments*viz*.; Farmer's practice: Removing/Burning of straw from field, tillage, planting and irrigation afterwards (T_1),CIP Technique: Flat planting of seed tubers after FYM & fertilizer application + covering with paddy straw mulch (T_2),Regional AICRIP/INSTITUTE recommendation/hoeing (T_3), Flat-bed planting: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) and no mulching or earthing (T_4), Flat-bed planting & mulching: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) + mulching by chopped straw and no earthing (T_5), Flat-bed planting & ridging: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) + earthing after 20-25 days by tilling soil between rows and no mulching (T_6) and Flat-bed planting, ridging and mulching: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and15 cm depth) and earthing after 20-25 days by tilling soil between rows + mulching of chopped straw after earthing (T_7) with 3 replications. The soil of experimental field was a sandy clay loam with uniform topography. The result showed that CIP Technique: Flat planting of seed tubers after FYM & fertilizer application + covering with paddy straw mulch (T_2)followed by Flat-bed planting, ridging and mulching: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and15 cm depth) and earthing after 20-25 days by tilling soil between rows + mulching of chopped straw after earthing (T_7) wereregistered superior valuesof growth parameters (plant height, number of compound leaves per plant and dry weight of haulm per plant), yield attributes (number of tubers per plant and dry weight of tubers per plant) as well as yield of potatoin both years as well as pooled over rest of the treatments.

***Key words**: Growth parameters, Potato, Tillage practices,Yield attributes, Yield*

INTRODUCTION

Potato (*Solanum tuberosum* L.) is an annual, herbaceous, tuber crop of Solanaceae family that contains all the essential food ingredients required for maintaining proper health (Gupta *et al*., 2014).

The global production of potato is around 375 million tones, India ranks 2nd in area and production of potato in the world after China (Anonymous, 2022-23b). In India, it is grown on an area of 2.35 million hectares with the production of 56 million tones and the productivity is 23829 kg/ha^{-1} (Anonymous, 2022-23a). Madhya Pradesh covers 158.14 thousand hectares with production of 3582 thousand tones and the productivity is 22651 kg/ha^{-1} (Anonymous, 2022-23).

Zero tillage systems such as no-tillage (NT) or direct drill, which plant directly through the mulch with minimal soil disturbance and diverse crop rotations are the practices that could maintain and improve soil quality.With the initiatives taken under international potato center (CIP), zero tillage potato cultivation has been fabulously adopted in various regions of the states. Farmers today can adopt the ZT potato cultivation practice as this system can give higher yield with limited labor and water use thus making the whole production system a lot more economic.

Potato is an important winter rotation and vegetable crop which provides a stable income for small holders in order to increase the knowledge and profits of farmers through the adoption of zero-tillage potato with rice straw mulch will promote climate-smart agriculture in addition to reduce environmental pollution caused by straw burning. More importantly, the use of rice straw for mulching puts nutrients back in the soil and reduces the emissions of greenhouse gases associated with the conventional practice of straw burning.

MATERIAL AND METHODS

An experiment was conducted during the *rabi* seasons of 2021-22 and 2022-23at the Research Farm, ICAR-Central Potato Research Station RS, Gwalior (M.P.). The experiment consisted of7 treatments*viz*.; Farmer's practice: Removing/Burning of straw from field, tillage, planting and irrigation afterwards (T_1),CIP Technique: Flat planting of seed tubers after FYM & fertilizer application + covering with paddy straw

Comment [p3]: please specify the name of the biological material used
if you have the climate data from the study period, it would be beneficial to present them

Comment [p4]: specify the period in months

mulch (T_2),Regional AICRIP/INSTITUTE recommendation/hoeing (T_3), Flat-bed planting: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) and no mulching or earthing (T_4), Flat-bed planting & mulching: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) + mulching by chopped straw and no earthing (T_5), Flat-bed planting & ridging: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) + earthing after 20-25 days by tilling soil between rows and no mulching (T_6) and Flat-bed planting, ridging and mulching: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and15 cm depth) and earthing after 20-25 days by tilling soil between rows + mulching of chopped straw after earthing (T_7)with 3 replications. The soil of experimental field was a sandy clay loam with uniform topography.

The studied for selected growth and yield attributes by using five plants in randomized manner in each plot.All other agronomic practices were adopted as per recommended package of practices. The data were statistically analysed using the F-test procedure given by Gomez and Gomez (1984). The difference between treatment means were compared with the critical differences (CD) at 5% level of probability (P=0.05).

RESULTS AND DISCUSSION

Comment [p5]: I recommend using a shorter term of the experimental variant because the detailed writing of the variants becomes tiresome when you present the results and they are repeated

Growth parameters:

The growth parameters *viz*.; plant height, number of compound leaves per plant and dry weight of haulm per plant were significantly varied among different treatments(Table 1). CIP Technique: Flat planting of seed tubers after FYM & fertilizer application + covering with paddy straw mulch (T_2)followed by Flat-bed planting, ridging and mulching: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and15 cm depth) and earthing after 20-25 days by tilling soil between rows + mulching of chopped straw after earthing (T_7) registered significantly higher value of growth parameters over rest of the treatments; while lowest values were observed under Flat-bed planting: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) and no mulching or earthing (T_4)during both the years as well as pooled. This

may be due to better soil health with reduced nutrient loss. The presence of crop residue mulch at the soil atmosphere interface has a direct effect on infiltration of rainwater into the soil and evaporation from the soil leading to improved soil water supply for crops. Therefore;better cell division, cell expansion and enlargement resulted higher value of growth parameters. Msheikh*et al*. (2019), Yarosone*t al.* (2019) and Rittie*t al.* (2023) also reported corroboratory findings in potato crop.

Yield attributes:

Different tillage practices significantly affectyield attributes *viz*.; number of tubers per plant and dry weight of tubers per plant (g) during both the years as well as pooled (Table 2). Significantly superior values of yield attributes were observed under CIP Technique: Flat planting of seed tubers after FYM & fertilizer application + covering with paddy straw mulch (T_2) followed by Flat-bed planting, ridging and mulching: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and15 cm depth) and earthing after 20-25 days by tilling soil between rows + mulching of chopped straw after earthing (T_7) over rest of the treatments; white lower values were noted by Flat-bed planting: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) and no mulching or earthing (T_4). This may be due to better and balanced availability of nutrients as compare to other treatments.The increase in yield attributes under these treatments may be attributed to concomitant reduction in weed dry matter that accounted for reductions in crop-weed competition, which provided congenial environment to proper utilization of growth factors *viz*., space, light, moisture and nutrient by the crop and henceforth attained superior values of yield attributes of potato.Similar results were also confined by findings of Duhlian*et al.* (2018) and Rittie*t al.* (2023).

Yield:

Yield is the economic part of the crop, which is based on availability of all favorable growth conditions; which play very crucial role in enhancement of yield attributes(Table 2).

CIP Technique: Flat planting of seed tubers after FYM & fertilizer application + covering with paddy straw mulch (T_2)followed by Flat-bed planting, ridging and mulching: Direct planting of potato by opening slit and covering it with soil (Root zone

tillage in 10 cm width and15 cm depth) and earthing after 20-25 days by tilling soil between rows + mulching of chopped straw after earthing (T_7)registered significantly maximum tuber yield (299.23 q/ha^{-1} and 282.44 q/ha^{-1}; respectively) over rest of the treatment; while minimum tuber yield (207.50 q/ha^{-1}) was observed under Flat-bed planting: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and 15 cm depth) and no mulching or earthing (T_4). This may be due to efficient utilization of growth factors; which result in better crop growth and development during all stages owing to weed free environment.Mulch provides an important habitat for natural enemies, which are vital for pest population regulation.Reduced tillage could be improving soil quality parameters, minimizing production cost, while also sustaining higher potato yield.Such results were also confirmed by findings ofMosquera*et al*. (2019), Yarason*et al.* (2019) andRitti*et al.* (2023).

CONCLUSIONS

For obtaining optimum value of growth parameters, yield attributes and higher yield of potato under semi-arid tract and sandy clay loam soils; CIP Technique: Flat planting of seed tubers after FYM & fertilizer application + covering with paddy straw mulch (T_2)followed by Flat-bed planting, ridging and mulching: Direct planting of potato by opening slit and covering it with soil (Root zone tillage in 10 cm width and15 cm depth) and earthing after 20-25 days by tilling soil between rows + mulching of chopped straw after earthing (T_7) was gave superior performancein both years as well as pooled over rest of the treatments.

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Table 1: Effect of tillage practices on growth parameters of potato

Treatment	Sy.	Plant height (cm)			Number of compound leaves per plant			Dry weight of haulm per plant (g)		
		2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
Farmer's practice	T_1	40.43	41.67	41.05	45.00	46.22	45.61	17.31	17.39	17.35
CIP Technique	T_2	45.30	46.03	45.67	48.80	49.97	49.38	24.68	24.77	24.73
Regional AICRIP/INSTITUTE recommendation/hoeing	T_3	44.40	45.30	44.85	48.03	49.20	48.62	23.43	23.57	23.50
Flat-bed planting	T_4	40.77	40.92	40.84	44.37	45.57	44.97	17.00	17.10	17.05
Flat-bed planting & mulching	T_5	42.97	43.53	43.25	46.90	48.10	47.50	20.41	20.66	20.53
Flat-bed planting & ridging	T_6	41.63	44.33	42.98	46.43	47.63	47.03	20.07	20.17	20.12
Flat-bed planting, ridging and mulching	T_7	44.98	45.89	45.43	48.50	49.70	49.10	23.93	24.07	24.00
SEm±		**0.63**	**0.66**	**0.32**	**0.49**	**0.56**	**0.26**	**0.47**	**0.48**	**0.24**
CD (5%)		**1.94**	**2.03**	**0.94**	**1.50**	**1.73**	**0.77**	**1.45**	**1.49**	**0.70**

Comment [p6]: I recommend using the term average

Table 2: Effect of tillage practices on yield attributes and yield of potato

Treatment	Sy.	Number of tubers per plant			Dry weight of tubers per plant (g)			Tuber yield (q/ha)		
		2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
Farmer's practice	T_1	7.69	7.75	7.72	50.40	51.73	51.07	203.67	214.00	208.83
CIP Technique	T_2	8.68	8.76	8.72	54.90	55.03	54.97	295.46	303.01	299.23
Regional AICRIP/INSTITUTE recommendation/hoeing	T_3	8.51	8.54	8.53	54.17	54.27	54.22	269.00	275.33	272.17
Flat-bed planting	T_4	7.64	7.68	7.66	50.03	51.37	50.70	202.33	212.67	207.50
Flat-bed planting & mulching	T_5	8.22	8.23	8.22	52.70	53.05	52.87	240.00	246.67	243.33
Flat-bed planting & ridging	T_6	8.04	8.07	8.06	52.17	52.53	52.35	232.33	242.33	237.33
Flat-bed planting, ridging and mulching	T_7	8.63	8.67	8.65	54.47	54.53	54.50	278.35	286.53	282.44
SEm±		**0.14**	**0.14**	**0.07**	**0.62**	**0.45**	**0.27**	**9.07**	**9.10**	**4.54**
CD (5%)		**0.43**	**0.43**	**0.21**	**1.90**	**1.38**	**0.79**	**27.96**	**28.03**	**13.26**

Comment [p7]: I recommend using the term average