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Effect of tillage practices and nutrient management on growth and yield of pearl millet (*Pennisetum glaucum* L.)

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Abstract

A field experiment entitled Effect of Tillage Practices and Nutrient Management on Growth and Yield of Pearl millet (*Pennisetum glaucum* L.) conducted during *kharif* 2024 at Agriculture farm, Suresh Gyan Vihar University, Jaipur on sandy loam soil. The treatments in pearl millet during *kharif* seasons comprising 12 combinations having three tillage practices zero, minimum and conventional tillage and 4 nutrient management treatments was laid out in a split plot design with three replications (control, 75% RDF, 100% RDF and 125% RDF). Pearl millet variety RHB-90 was sown at 45 cm row spacing using seed rate of 05 kg ha⁻¹.

The results showed that adoption of conventional tillage treatments significantly increased the effective tillers, ear length, number of grains per ear, seed, stover and biological yield of pearl millet as compared to zero tillage and remained statistically at par with minimum tillage. The per cent increase in the net return of pearl millet with conventional and minimum tillage was to the extent of 42.55 and 35.05 per cent over control, respectively. The maximum effective tillers, ear length, number of grains per ear, seed, stover and biological yield of pearl millet as compared to control and 75% RDF and remained statistically at par with 100% RDF. The per cent increase net return of pearl millet with 125% RDF, 100% RDF and 75% RDF was to the extent of 114.28, 105.50 and 91.57 per cent over control, respectively.

Keywords: Grain, RDF, straw, tillage, yield

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R.Br.] has been widely farmed, mostly in Africa and the Indian subcontinent. Millets have very high dietary carbohydrate content (60–70%), fibre content (10–12%) and low fat (1.5–5%), and a significant mineral content (2–4%) (Annor *et al.* 2017) ^[1]. 7.35 million hectares under cultivation and a yearly yield of 10.72 million tonnes, or 1455 kg/ha, India topped the world (GOI 2025). Rajasthan, the “National Leader in Pearl Millets” is having largest area and highest production in the country under pearl millet. The State occupies about 46 lakh-hectare area with an average production of about 28 lakh tons and productivity of 400 kg per hectare (GOR 2025).

Conventional tillage practices can adversely affect the soil productivity over the long term due to soil erosion, microbial activity, and loss of organic matter (Dalal *et al.* 2021) ^[7]. Agricultural practices toward lesser soil degradation are needed to improve soil quality and agricultural sustainability (Jat *et al.* 2024) ^[10]. No tillage, or planting with minimal soil disturbance combined with crop rotations protects the soil against degradation toward sustainability. The shifting from conventional till with residue burning/removal to no-till farming with residue retention practices are important soil management practices for improving soil health and preventing land degradation, and increasing soil organic carbon (Mohanty *et al.* 2020) ^[19].

Integrated nutrient management (INM) is a practices where all sources of nutrients namely organic, inorganic (chemical fertilizer), biofertilizer can be combined use for improving and maintenance of soil fertility, supply of plant nutrients, soil health get good quality yield and also maintain ecology and environment. Agriculture remains a soil-based industry (Saini *et al.* 2024) ^[33].

The concept of Integrated Nutrient Management (INM) is a continuous improvement of soil productivity on long term basis through appropriate use of fertilizers, organic manures along with biofertilizers for optimum growth, yield and quality of different crops and cropping systems in specific agro-ecological situations.

Methods and Materials

The experiment was conducted during *kharif* 2024 at Agronomy farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur. Geographically, the study area is located at 75°48'84" E longitude and 26°82'47" N latitude and this region falls under agro-climatic zone III A (Semi-arid Eastern Plain Zone) of Rajasthan. The treatments in pearl millet during *kharif* seasons comprising 12 combinations having three tillage practices zero, minimum and conventional tillage and 4 nutrient management treatments was laid out in a split plot design with three replications (control, 75% RDF, 100% RDF and 125% RDF).

Results and Discussion

Effect of tillage

The maximum number of effective tillers per plant and number of seeds per ear was recorded with conventional tillage over zero tillage but remained statistically at par with minimum tillage. The per cent increase of ear head length of pearl millet with conventional tillage and minimum tillage was to the extent of 23.27 and 22.44 per cent over zero tillage, respectively. Superior performance under conventional tillage with mulch can be attributed to enhanced soil aeration, better root development, and improved nutrient uptake facilitated by tillage, all of which contribute to increased plant vigour and tillering capacity (Patel *et al.*, 2020) [22]. The improved yield attributes in conventional tillage may be attributed to enhanced soil moisture retention, moderated soil temperatures, and improved nutrient uptake, which collectively create optimal conditions for reproductive growth and assimilate allocation. These benefits promote better sink development. These findings agree with the studies by Chaudhary *et al.* (2016) and Patil *et al.* (2019) [23].

This increase in yield and yield attributes could be attributed to improvement in growth attributes under the influence of different tillage treatments, as stated earlier, through increased availability of soil moisture and nutrients, which favourably influenced physiological processes of the plants and buildup of food material (Mishra *et al.* 2024). Significant improvement in grain and straw yield under conventional tillage treatment seems to be an outcome of increased dry matter accumulation right from early stages of crop growth till harvest due to favourable soil and plant environment so obtained under the influence of tillage practices, which led to increased photosynthetic efficiency under this treatment. Chaudhary *et al.* (2016) and Mishra *et al.* (2024).

The maximum seed, stover and biological yield of pearl millet was recorded with conventional tillage over zero tillage but remained statistically at par with minimum tillage. The per cent increase of seed yield of pearl millet with conventional tillage and minimum tillage was to the extent of 48.83 & 39.17 per cent over zero tillage, respectively (Basu *et al.* 2024) [2]. In comparison with conventional tillage, improved physical condition, higher SOC content, and better nutrient availability under zero tillage techniques resulted in higher yield reported by Silva *et al.* (2022) [38] and Raghuvansi *et al.* (2024) [26].

The per cent increase in the net return of pearl millet with conventional and minimum tillage was to the extent of 42.55 and 35.05 per cent over control, respectively. The maximum B: C ratio of pearl millet was observed in minimum tillage (2.27) that was closely accompanied by conventional tillage (2.17). The per

cent increase in the B: C ratio of pearl millet with minimum and conventional tillage was to the extent of 20.73 and 15.26 per cent over control, respectively. The higher net return and B:C ratio obtained in minimum tillage may be due of tillage operations in conservation tillage practice. These results are in agreement with the findings of Mishra and Singh (2012) [18].

Effect of integrated nutrient management

It is further evident from data (Table 4.4) that number of effective tillers per plant, number of grains per ear and ear head length of pearl millet of pearl millet was significantly influenced due to nutrient management. The maximum number of effective tillers per plant, number of grains per ear and ear head length of pearl millet was recorded with 125% RDF over control and 50% RDF but remained statistically at par with 100% RDF. The findings of the present investigation are in close conformity with those reported by Choudhary *et al.* (2021) [5], who observed that application of recommended and higher fertility levels significantly improved effective tillers, ear head length and grains per year in pearl millet due to enhanced nutrient availability and improved physiological efficiency of the crop. Similar results were reported by Kumar and Yadav (2022) [11], who concluded that balanced fertilization significantly increased yield attributes by promoting better vegetative growth and efficient partitioning of assimilates towards reproductive structures.

The maximum seed, stover and biological yield of pearl millet were recorded with 125% RDF over control and 50% RDF but remained statistically at par with 100% RDF. The increase in seed yield with 125% RDF was mainly associated with the higher number of effective tillers, increased grains per ear and longer ear heads observed under improved nutrient availability. These yield attributes enhanced the sink capacity of the crop and facilitated efficient translocation of photosynthates towards developing grains, resulting in superior grain filling and higher seed yield Choudhary *et al.* (2024) [6] and Poonia *et al.* (2026) [24].

The maximum net return of pearl millet was observed in 125% RDF that was closely accompanied by 100% RDF and 75% RDF. The maximum B: C ratio of pearl millet was observed in 75% RDF (2.40) that was closely accompanied by 125% RDF (2.05) and 100% RDF (2.01). The per cent increase B: C ratio of pearl millet with 75% RDF, 125% RDF and 125% RDF was to the extent of 22.54, 4.99 and 2.91 per cent over control, respectively. Higher net returns under treatment under 125% RDF might be owing to more returns from higher grain yield as compared to cost involved under this treatment Rani *et al.* (2017) [30].

Table 1: Effect of tillage practices and nutrient management on yield attributes

Treatments	No. of Effective tillers/plant	Ear head length (cm)	No. of seeds/ear
Tillage practices			
Zero	2.50	18.42	1010
Minimum	2.60	19.17	1237
Conventional	3.03	21.08	1245
SEm±	0.15	0.36	23
CD=0.05%	0.44	1.06	68
Nutrient management			
Control	2.14	13.67	872
75% RDF	2.74	20.44	1208
100% RDF	2.92	21.56	1263
125% RDF	3.04	22.56	1314
SEm±	0.17	0.42	27
CD=0.05%	0.51	1.22	79

Table 2: Effect of tillage practices and nutrient management on yields (kg/ha)

Treatments	Seed	Straw	Biological
Tillage practices			
Zero	1411	6367	7778
Minimum	1964	6776	8740
Conventional	2100	7622	9722
SEm±	35	104	112
CD=0.05%	104	306	329
Nutrient management			
Control	1234	4887	6121
75% RDF	1879	7326	9205
100% RDF	2021	7794	9814
125% RDF	2168	7680	9847
SEm±	41	121	130
CD=0.05%	120	353	380

Table 3: Effect of tillage practices and nutrient management on economics

Treatments	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
Tillage practices			
Zero	60750	37237	1.88
Minimum	76202	50290	2.27
Conventional	82995	53083	2.17
SEm±	1002	1002	0.04
CD=0.05%	2939	2939	0.13
Nutrient management			
Control	50389	26356	1.96
75% RDF	76273	50489	2.40
100% RDF	81694	54160	2.01
125% RDF	84908	56474	2.05
SEm±	1157	1157	0.05
CD=0.05%	3394	3394	0.15

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