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Effect of Efficient Tillage and Nutrient Management on Growth, Yield, Content Anduptake by Pearl Millet under Semi-Arid Conditionsinceptisols

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ABSTRACT: A fieldexperiment was conducted in All India Coordinated Research Project for Dry Land Agriculture (ICAR) at research farm of R. B. S. College, Bichpuri, Agra during kharif season of 2006-07 in plot no. 15 (A) it is located at distance of 11 KM west of Agra city at Agra-Bharatpur road. It is situated at a latitude of 27.27^{o} N and longitude 77.9^{0}E and 163.48 meter above the mean sea level. To observe effect of efficient tillage and nutrient management on growth, yield, content and uptake by Pearl Millet (Pennisetum glaucum L.) under semi-arid conditions Inceptisols. The experiment was laid out in split plot design (SPD) under semi-arid Inceptisols in Agra region. Consisted nine treatments viz., T_1: 100% N (through organic source) + conventional tillage (CT) + inter-culture T2 : 50% N (through organic source) + 50 % N (through inorganic source) +conventional tillage (CT) + Inter-culture T_3 :100% N (through inorganic source) + conventional tillage (CT) + Inter-culture T_4 :100% N (through organic source) + low tillage (50% of CT) + inter-cultureT_5 :50% N (through organic source) + 50 % N (through inorganic source) + low tillage (50% of CT) + inter-culture T_6 :100% N (through inorganic source) + low tillage (50% of CT) + inter-culture T_7:100% N (through organic source) + low tillage (50% of CT) + inter-culture + weedicide T_8 : 50% N (through organic source) + 50 % N (through inorganic source) + low tillage (50% of CT) + inter-culture + weedicide T_9 : 100% N (through inorganic source) + low tillage (50% of CT) + inter-culture + weedicide.Resultsrevealed that the application of treatmentT2: 50% N (through organic source) + 50 % N (through inorganic source) +conventional tillage (CT) + Inter-culture is significantly superior overrest of the treatments. Conservation tillage practices should reduce pearl millet production costs by saving time, fuel, and fertilizer, but there is little information available concerning recommendations. In present study we summarize recent research, developments, and experiences in developing no-till practices and identifying improved varieties for more cost-effective production.

Key words: Pearl millet, organic and inorganic sources, inter-culture, conventional tillage (CT) and weedicide etc.

I. INTRODUCTION

Rainfed agriculture plays an important role in contributing to world food security in India, the land area under rainfed agriculture is about 86 million ha.representing about 60% of net cultivated area and it supports 40% of the population of the country. In sub-Saharan Africa, more than 95% farm land is rainfed, while the corresponding figure for Latin America is almost 90%, for South Asia about 60%, for East Asia 65%, and for the Near East and North Africa 75% (Wani et al., 2009). In addition to the climatic constraints such as erratic and uncertain rainfall patterns, soils in the rainfed areas are highly degraded physically, chemically and biologically (MaruthiSankar et al., 2010a; Sharma et al, 2005; Vittal et al., 2003). Practices such as zero or reduced tillage, green manuring, recycling of crop residues, have proved effective in improving soil fertility and soil quality in irrigated and temperate regions (Unger, 1990). No-tillage (NT) farming, practiced in combination with growing a cover crop in the rotation cycle, is widely recognized as a viable alternative to plough tillage as a way to improve the environment and sustain natural resources. Benefits of no tillage /zero farming (e.g. erosion control, water conservation, soil fertility enhancement, C sequestration) are directly attributed to the amount of crop residue mulch and application of

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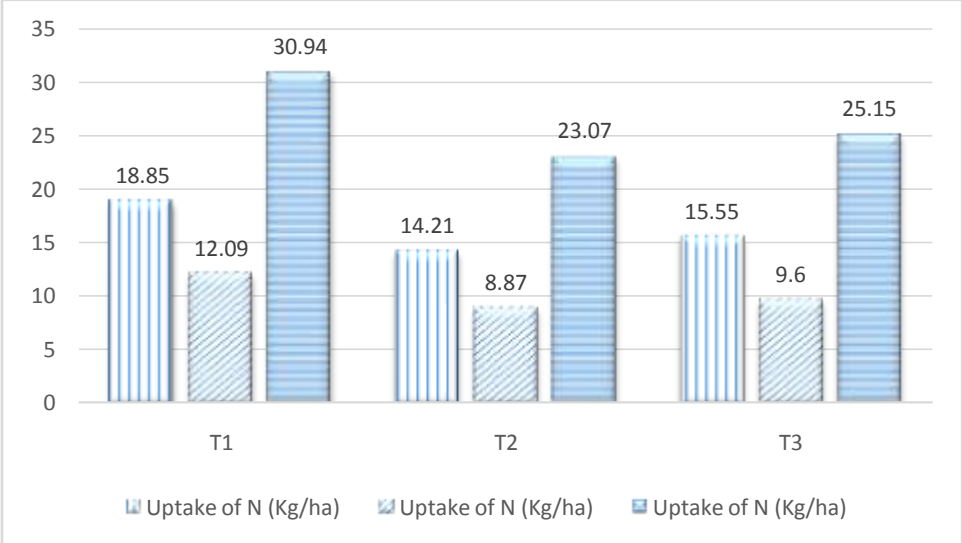
dung/manure as soil amendments (Lal, 2007). However, in tropical countries like India, after harvesting of the crops, residue is removed from the soil surface for feeding livestock and / or to use it as fuel for domestic cooking. Beside this, owing to moisture scarcity in rainfed areas, there is very little scope to grow green manure and biomass generating crops in rainfed regions without losing the regular cropping season. It has been reported that elimination of summer fallowing in arid and semi-arid regions and adopting no-till with residue mulching improves soil structure, lowers bulk density, increases infiltration capacity (Lal, 2004; Shaver et al., 2002) and ultimately enhances crop productivity. Minimum tillage maintains lower temperature, water, oxygen and thereby induces suitable environments for the growth and activity of micro-flora and micro-fauna (Blevins and Frye, 1993; Follet, 1990). Thus, optimum tillage operations combined with weed and fertilizer management would be essential not only to enhance the productivity of crops but also to maintain soil health and sustainability over a long period (MaruthiSankar et al., 2006; Nema et al., 2008).

Table: 01 Uptake of nitrogen (Kg/ha) by grain, Stover and total produce as affected by various treatment.



Treatments	Uptake of N (Kg/ha)		
	Grain	Stover	Total produce
Tillage			
Conventional tillage (CT) + inter-culture	18.85	12.09	30.94
Low tillage (50% of CT) + inter-culture	14.21	8.87	23.07
Low tillage (50% of CT) + inter-culture + weedicide	15.55	9.60	25.15
SEm_+	0.041	0.39	0.43
CD (0.05)	1.42	1.33	1.49
Nutrient			
100% N (through organic source)	14.26	8.90	23.15
50% N (through organic source) + 50 % N (through inorganic source)	18.67	11.56	30.23
100% N (through inorganic source)	15.68	10.08	25.76
SEm_+	0.32	0.32	0.52
CD (0.05)	0.94	0.95	1.53

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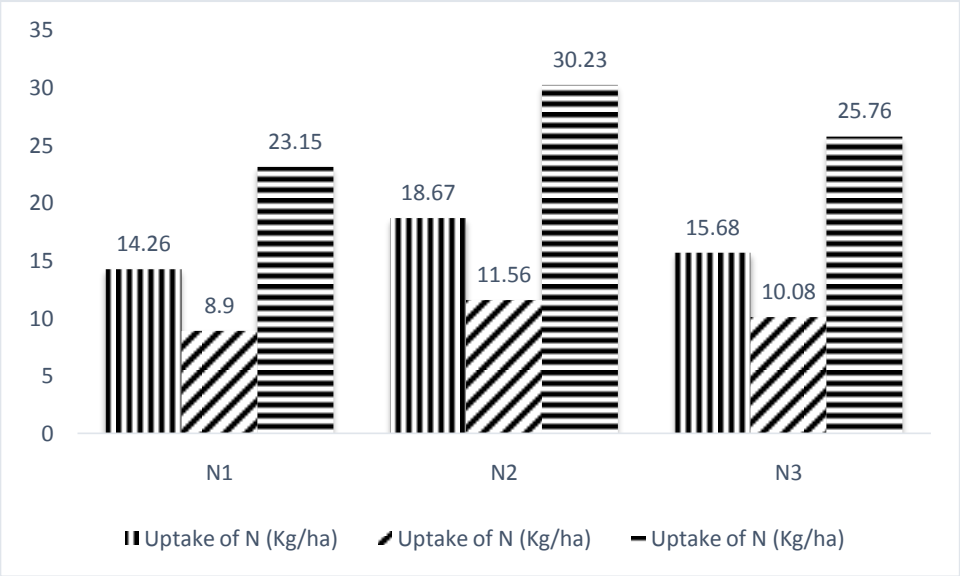
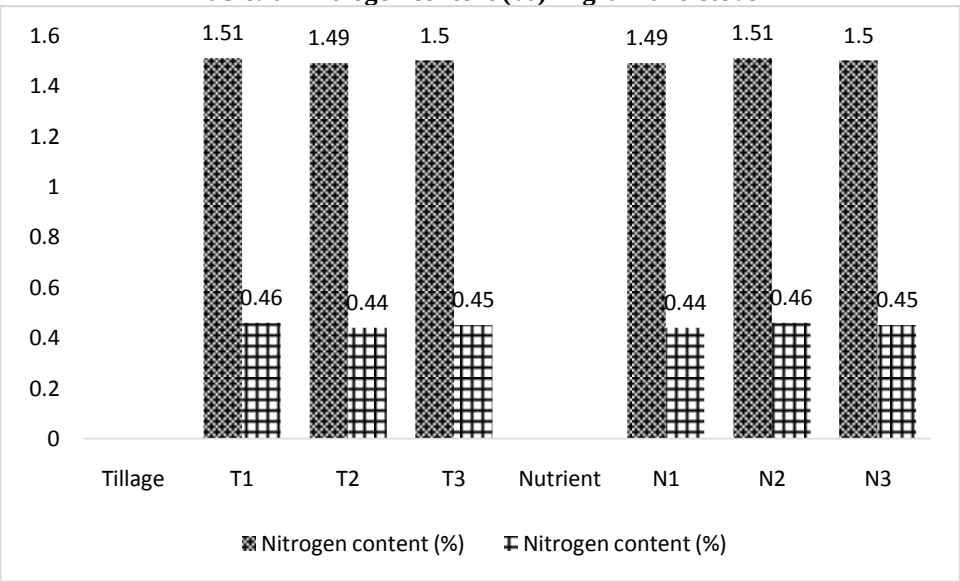


EFFECT OF TILLAGE

The uptake of nitrogen bygrain and stover as well as through total produce was significantly influenced due to different tillage practice (Table: 01). Conventional tillage (CT) + inter-culture resulted in significantly higheruptake of nitrogen by 30.54 and 21.22 percent in grain, 36.3 and 25.94 percent in stover and 34.11 and 23.02 percent in total produce, respectively than that of low tillage (50% of CT) + interculture and low tillage (50% of CT) + inetrculture + weedicide.

The difference in uptake of nitrogen due to low tillage treatments were at par except total produce where low tillage (50% of CT) + interculture + weedicide also had appreciable higher total uptake than low tillage (50% of CT) + interculture.

Table: 02 Nitrogen content (%) in grain and stover



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Treatments	Nitrogen content (%)	
	Grain	Stover
Tillage		
Conventional tillage (CT) + inter-culture	1.51	0.46
Low tillage (50% of CT) + inter-culture	1.49	0.44
Low tillage (50% of CT) + inter-culture + weedicide	1.50	0.45
SEm_+	0.01	0.01
CD (0.05)	NS	NS
Nutrient		
100% N (through organic source)	1.49	0.44
50% N (through organic source) + 50 % N (through inorganic source)	1.51	0.46
100% N (through inorganic source)	1.50	0.45
SEm_+	0.01	0.01
CD (0.05)	NS	NS

NS: Non Significant

EFFECT OF NUTRIENT

The data presentedin (Table: 02) indicate that the application of 50% N (through organic source) + 50 % N (through inorganic source) gave appreciable higher uptake of nitrogen by 30.93 and 19.07 percent in grain, 33.37 and 14.57 percent in stover and 30.58 and 16.26 percent in total produce, respectively than 100% N (through organic source)and 100% N (through inorganic source). Application of 100% N (through inorganic source) also gave significantly higher uptake N by 9.96, 13.37 and 11.36 percent by grain, stover and total produce, respectively.

SIGNIFICANT INTERACTION ON THE UPTAKE OF NITROGEN

The interaction effect of tillage and nutrient levels on uptake of nitrogen in grain and stover as well as total uptake was found to significant. The respective data so obtained have been displayed in (Table: 01a, 01b and 01c) the uptake of nitrogen was significantly higher through grain and stover, and through total produce with conventional tillage (CT) + interculture and 50% N (through organic source) + 50 % N (through inorganic source) that than recorded with low tillage (50% of CT) treatments and 100% N either (through organic source) or 100 % N (through inorganic source) and conventional tillage (CT) + interculture and 100% N either (through organic source) or 100 % N (through inorganic source) inorganic source combination also had appreciably higher uptake of nitrogen through grain, stover and total produce than rest combinations except low tillage (50% of CT) + interculture + weedicide and 100% N (through inorganic source) where the difference was not well marked.

Table: 01a Interaction effect of tillage and nutrient levels on the uptake of N bygrain.

Tillage	Nitrogen levels (Kg/ha)		
	N_1	N_2	N_3
Conventional tillage (CT) + inter-culture	15.16	23.49	17.89
Low tillage (50% of CT) + inter-culture	13.61	14.33	14.71
Low tillage (50% of CT) + inter-culture + weedicide	13.99	18.19	14.45
SEm_+			0.55
CD (0.05)			1.63

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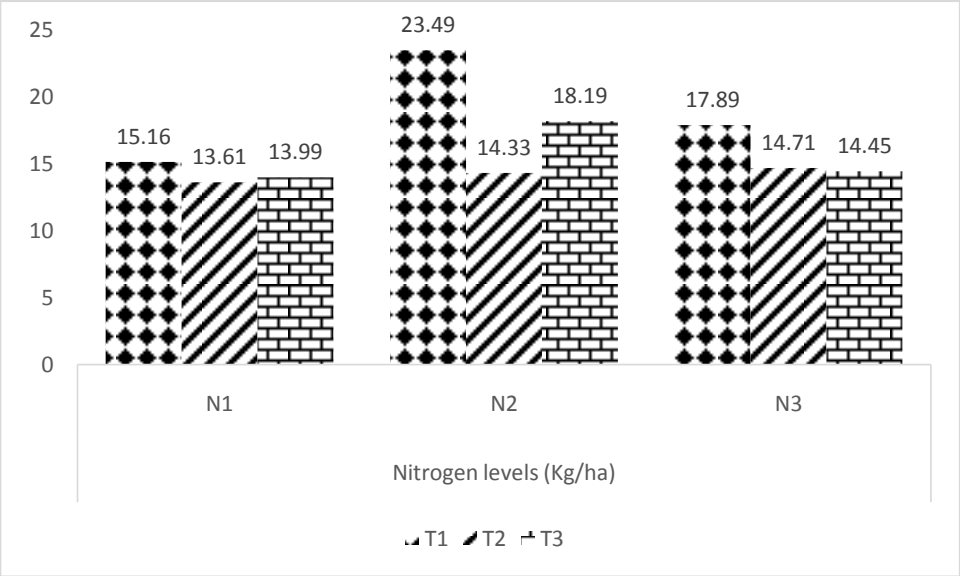
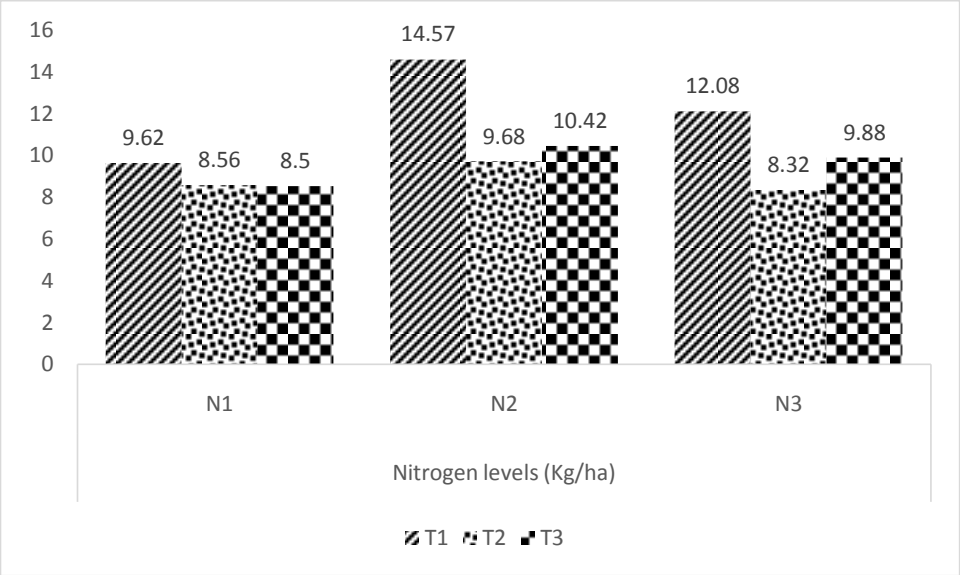


Table: 01b Interaction effect of tillage and nutrient levels on uptake of N bystover



Tillage	**Nitrogen levels (Kg/ha)**		
	N_1	**N_2**	**N_3**
Conventional tillage (CT) + inter-culture	9.62	14.57	12.08
Low tillage (50% of CT) + inter-culture	8.56	9.68	8.32
Low tillage (50% of CT) + inter-culture + weedicide	8.50	10.42	9.88
SEm_+			0.55
CD (0.05)			1.64

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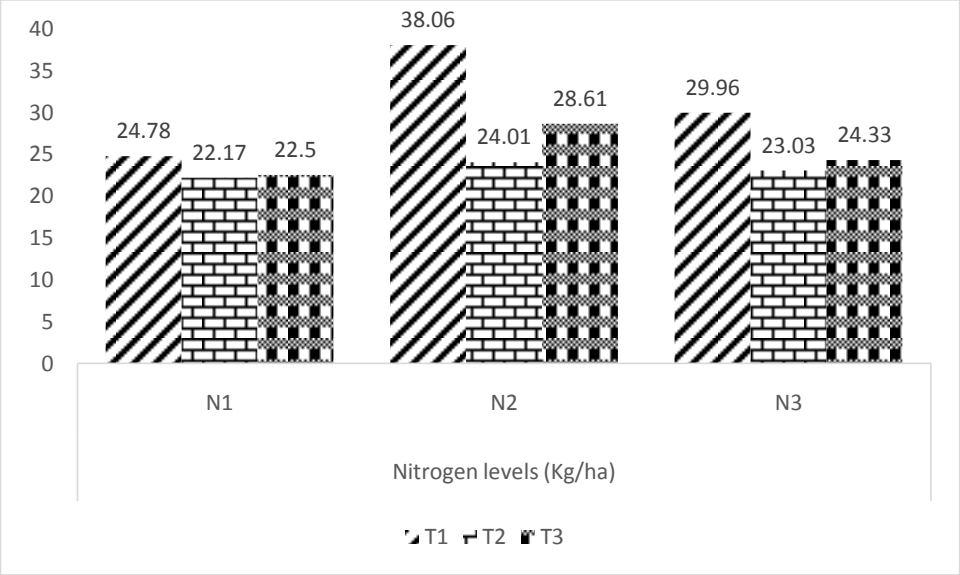
Table: 01b Interaction effect of tillage and nutrient levels on uptake of N through total produce.



Tillage	Nitrogen levels (Kg/ha)		
	N_1	N_2	N_3
Conventional tillage (CT) + inter-culture	24.78	38.06	29.96
Low tillage (50% of CT) + inter-culture	22.17	24.01	23.03
Low tillage (50% of CT) + inter-culture + weedicide	22.50	28.61	24.33
SEm_+			0.89
CD (0.05)			2.65

EFFECT OF NUTRIENT

The data presented in (Table: 01a, 01b and 01c) indicated that the application of 50% N (through organic source) + 50 % N (through inorganic source) gave appreciable higher uptake of nitrogen by 30.93 and 19.07 percent in total produce, respectively than 100% N either (through organic source) and 100 % N (through inorganic source). Application of 100 % N (through inorganic source) also gave significantly higher uptake of N by 9.96, 13.37 and 11.36 percent through grain, stover and total produce, respectively.

II. RESULTS AND DISCUSSION

EFFECT OF TILLAGE PRACTICE

GROWTH AND DEVELOPMENT STUDIES

Conventional tillage (CT) + interculture treatment had significantly higher number of tillers per plant than low tillage (50% of CT) + interculture and low tillage (50% of CT) + interculture + weedicide at all the stages of crop growth as well as at harvest. The maximum shoot height was recorded with conventional tillage (CT) + interculture with and without weedicide at all the stages of crop growth except at 30 DAS. Conventional tillage (CT) + interculture total produced appreciably more dry matter per plant than low tillage (50% of CT) treatments + interculture with and without weedicide at all the stages of crop growth except at 30 DAS. Conventional tillage (CT) + interculture delayed 50% earing by 7th days and maturity by 8 days than that of low tillage (50% of CT) + interculture and low tillage (50% of CT) + interculture + weedicide.

YIELD AND YIELD ATTRIBUTES

Yield attributes such as effective tillers per plant, ear head weight and length, grain weight per ear head were significantly improveddue to conventional tillage (CT) + interculture over low tillage (50% of CT) treatments + interculture with and without weedicide. The different tillage had no significant effect on ear girth and 1000 grain weight. Conventional tillage (50% of CT) + interculture treatment had significantly high grain yield by 21.4 and 21.1 percent, stover yield by 32.6 and 26.6 percent and total dry matter yield per hectare by 32.2 and 18.4 percent than that obtained

with low tillage (50% of CT) + interculture + weedicide, respectively. The different tillage treatments had no significant effect on harvest index.

QUALITY AND QUALITY UPTAKE STUDIES

Protein content (%) in grain and stover did not modify much due to tillage treatments. Tillage treatments also did not exert any significant effect on nitrogen content (%) in grain and stover. Conventional tillage (CT) + interculture had appreciably high production of protein and uptake of nitrogen in grain, stover and in total produce of pearl millet the low tillage (50% of CT) treatments + interculture with and without weedicide.

EFFECT OF NUTRIENT (N)
GROWTH AND DEVELOPMENT

Application of 50% N (through organic source) + 50 % N (through inorganic source) resulted in significantly higher number of tillers per plant, plant height and dry matter accumulation per plant than 100 % N (through organic and inorganic source) almost at all the stages of crop growth except at 30 DAS, in case of plant height and dry matter accumulation per plant. Application of 100 % N (through organic source) resulted in significantly 50 percent earing and maturity than 50% N (through organic source) + 50 % N (through inorganic source) and 100% N (through inorganic source).

YIELD AND YIELD ATTRIBUTES

Yield attributes of pearl millet were significantly improved with the application of 50% N (through organic source) + 50 % N (through inorganic source) over 100% N through organic or inorganic sources. Application of 50% N (through organic source) + 50 % N (through inorganic source) resulted in significantly higher grain yield by 29.8 and 18.8 percent, stover yield by 25.6 and 14.0 percent and total produce dry matter yield per hectare by 26.9 and 15.8 percent, respectively than that of 100% N through organic or inorganic sources. Different sources of nitrogen had no significant impact on harvest index.

QUALITY AND UPTAKE STUDIES

The application of nitrogen through different sources had no significant impact on protein content (%) in grain and stover. The N content (%) in grain and stover also did not modify due to different sources of nitrogen. Application of 50% N (through organic source) + 50 % N (through inorganic source) had appreciably more production of protein and uptake of nitrogen in grain and stover as well as in total produce.

RESULT: Basedupon the results of present investigation the following conclusions may be drown. Application of 50% N (through organic source) + 50 % N (through inorganic source) resulted in appreciably higher grain yield by 29.8 and 18.8 percent than that of 100% N through organic or inorganic sources, respectively. Conventional tillage (CT) + interculture had appreciably higher total produce uptake of nitrogen than low tillage (50% of CT) + interculture treatments with and without weedicide. Application of 50% N (through organic source) + 50 % N (through inorganic source) also had significantly high total uptake of nitrogen than 100% N through organic and inorganic sources.

Based on the conclusion drawn, it is recommended that pearl millet crop should be grown with conventional tillage (CT) + interculture along with 50% N (through organic source) + 50 % N (through inorganic source) under dry land condition of Agra region.

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