EVALUATING THE PERFORMANCE OF TILLAGE AND ORGANIC NUTRIENT MANAGEMENT PRACTICES ON GROWTH CHARACTERISTICS AND YIELD ATTRIBUTES OF LITTLE MILLET (*PANICUM SUMATRENSE* L.)

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Selection of suitable tillage and application of organic sources are essential that influencing the efficiency of nutrients in soil and crop management. To improve the millet crop yield and to sustain the soil health, inclusion of primary tillage and recommended nutrient management practices through organic sources are very much needed. With this preview, the research was carried out and objective of this study was to investigate how the tillage systems and different organic sources affect the crop growth and yield of little millet. An experiment was conducted in the research farm of Tamil Nadu Agricultural University, Coimbatore during 2022. For conducting an experiment, the strip plot design was laid out with tillage as the main plot and nutrient management practices as a subplot with 3 replications. Results revealed that conventional tillage (Disc plough + Cultivator + Rotovator) with the application of enriched vermicompost @ 1 t ha^{-1} followed by foliar spray of 3% *Panchagavya* on 30^{th} DAS and 5% of egg amino acid on 45^{th} DAS had a greater effect on growth parameters, crop growth indices and yield attributes of little millet as compared to the other treatments. This research delves into investigating the effect of tillage with organic nutrient management practices on the growth and yield attributes of little millet.

Keywords: Tillage, organic nutrient management, foliar spray, little millet

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*****PhD scholar, Department of Agronomy, TNAU, Coimbatore-03, Email: jvanathi7@gmail.com Abstract

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1. Introduction

Millets are traditional cereal crops in the developing world which play an important role because of their use as human food as well as feed. According to [6], the global millet production in 2019-20 was 84.17 million metric tonnes from an area of 70.75 million hectares of which 20.50% was produced in India. India is the world's largest producer of pearl millet, finger millet, little millet, kodo millet, and barnyard millet with an annual production of around 12.46 million metric tonnes from an area of 8.87 million hectares [1]. In recent years, consumers moving towards small millet because of its high beneficiaries and also very conscious about what they are consuming, especially obese people. Millets are adapted to a wide range of environmental conditions but the worst part is that area under minor millet production is shrinking over the last decades. So, scientists and researchers should focus more on good management practices on millet production which should give more yield and income for the farmer like other crops, so that consumers can benefit from the nutrient rich millet.

Little millet is referred to as Indian millet mostly used by the poor people in the tribal areas of India. It is a short duration, quick germinating, and also climate resilient crop tolerant to extreme drought and water—logging conditions. It is mainly cultivated in the states of Karnataka, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Gujarat, Chhattisgarh, and Maharashtra.

Tillage is the process that greatly influences soil properties and crop yield that contributes up to 20% [12]. It plays an essential role in the soil-plant systems through higher nutrient use efficiency in the soil with sustainable use of available resources [10]. The trend of utilizing organic manures for crop production in the present scenario was improved which tends to have a beneficial effect on soil fertility and productivity and strengthen the ecological status of crop husbandry [25]. The main aim of organic farming is to reduce the use of external inputs and maximization of crop productivity results well in enhancing the soil quality through higher soil enzymatic activities [5]. At the same time, the food habits of consumers are changing rapidly. Nowadays, demand for organic food products was increased especially in Nutri-cereals. Therefore, there is an urgent need to focus their attention on millet farming and create an enabling environment for millet farmers.

To enhance the soil fertility status and crop productivity organically, it is necessary to introduce organic nutrient sources with appropriate tillage practices for effective management in the agricultural system. Based on this consideration, a new immersing attempt was made to develop and identify suitable tillage practices and nutrient management through manures and foliar nutrition on the growth and yield of little millet.

2. Material and Methods

2.1. Site description

This study was performed during the year 2022 at the experimental farm of the Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore. The experimental site was located in the western zone of Tamil Nadu at a longitude of 76°97′E and latitude of 11°08′N with an elevation of 426 m above MSL. The soil of the experimental site was sandy clay loam in texture, slightly alkaline in nature.

2.2. Experimental Design

The experimental layout was done using a strip plot design with three replicates consisting of two factors *viz*., vertical and horizontal strips. The vertical strip includes conventional tillage and farmer's practice as the main plot whereas the horizontal strip comprises nutrient management practices as a sub plot.

2.2.1. Treatment Details

Tillage practices (Vertical strips)

T_1- Conventional tillage (Disc plough + Cultivator + Rotovator)

T_2- Farmer's practice (Cultivator + Rotovator)

Nutrient management practices (Horizontal strips)

N_1 - FYM @ 12.5 t ha^{-1} + Foliar spray of 3% *Panchagavya* on 30^{th} DAS + 3% vermiwash on 45^{th} DAS

N_2 - EFYM @ 1 t ha^{-1} + Foliar spray of 3% *Panchagavya* on 30^{th} DAS +5% egg amino acid on 45^{th} DAS

N_3 -VC @ 2.5 t ha^{-1} + Foliar spray of 3% *Panchagavya* on 30^{th} DAS + 3% vermiwash on 45^{th} DAS

N_4- EVC @ 1 t ha^{-1} + Foliar spray of 3% *Panchagavya* on 30^{th} DAS+ 5% egg amino acid on 45^{th} DAS

N_5 - GM @ 2.5 t ha^{-1} + Foliar spray of 3% *Panchagavya*on 30^{th} DAS+ 5% vermiwash on 45^{th} DAS

N_6 - RDF of NPK fertilizers + Foliar spray of water on 30^{th} & 45^{th} DAS

N_7- Absolute control

* FYM- Farm yard manure; EFYM- Enriched farm yard manure; VC- Vermicompost; EVC- Enriched vermicompost; GM- Goat manure; RDF- Recommended dose of fertilizers

2.2.2. Preparation of *Panchagavya*

Panchagavya consists of five products namely cow dung, cow urine, milk, curd, and ghee. For preparing *Panchagavya*, a wide-mouthed plastic container was used. First, the fresh cow dung and ghee were taken into the container and mixed thoroughly twice a day for 3 days. On the fourth day rest of the ingredients were added and stirred twice a day for 15 days. The stock solution was ready after the 20th day [16]. It was kept in the shade and covered with a plastic mosquito net to prevent houseflies from laying eggs and the formation of maggots. 3% solutions were used for spraying as per the treatment. 15 liters of *Panchagavya* in 500 liters of water were applied @ 3 % solutions respectively for 1 ha. After dilution, the *Panchagavya* solution was filtered and sprayed through a knapsack sprayer. The nutrient composition of *Panchagavya* was given in the Table 1.

2.2.3. Preparation of egg amino acid

20 ripened lemons were squeezed well and juice was collected in a plastic container. 10 numbers eggs were added to the lemon juice till the eggs were soaked completely and then kept for 10 days for fermentation. After 10 days, eggs were smashed well and 250 g of jaggery was added and allowed for another 10 days. The liquid portion was filtered, collected, and stored in a separate container for foliar spray [2]. From the stock solution, 5 per cent concentration was prepared as per treatment. 25 liters of egg amino acid were diluted in 500 liters of water was applied for 1 ha @ 5 % solutions. The nutrient composition of egg amino acid was given in Table 1.

Table 1. Nutrient composition of organic sources

S.No	Organic sources	Nitrogen %	Phosphorous %	Potassium %
1.	Farm yard manure	0.48	0.27	0.46
2.	Enriched farm yard manure	1.67	1.55	1.23
3.	Vermicompost	1.83	0.94	1.11
4.	Enriched vermicompost	1.96	2.13	1.92
5.	Goat manure	0.78	0.07	0.63
6.	*Panchagavya*	0.96	0.52	0.76
7.	Egg amino acid	1.04	0.91	0.83
8.	Vermiwash	0.87	0.48	0.94

2.3. Soil physical and chemical properties

Initial soil samples are collected from the depth of 0-10, 10-20 and 20-30 cm intervals for estimation of pH, EC, bulk density, particle density, porosity, and NPK status was determined and given in Table 2. Soil organic carbon was determined and organic matter was calculated by multiplying organic carbon by 1.724.

Table 2. Initial soil physical and chemical properties

1. Physical properties				
Soil depth (cm)	0-10 cm	10-20 cm	20-30cm	
pH	7.89	8.02	8.73	Jackson [11]
EC (dSm^{-1})	0.34	0.23	0.12	
Bulk density ($mg\ m^{-3}$)	1.13	1.19	1.24	Cylindrical method
Particle density ($mg\ m^{-3}$)	1.49	1.39	1.35	
Porosity (%)	24.00	21.62	20.50	
2. Chemical properties				
Available Nitrogen ($kg\ ha^{-1}$)	213.6	195.5	187.6	Alkaline potassium permanganate method [30]
Available phosphorus ($kg\ ha^{-1}$)	16.05	14.76	13.11	Colorimetry [17]
Available potassium ($kg\ ha^{-1}$)	407.3	386.5	371.2	Flame photometer method [29]
Organic carbon (%)	0.53	0.39	0.31	Wet oxidation method [34]
Organic matter %	0.91	0.67	0.53	

2.3. Crop husbandry and field management

The field was well prepared as per the treatment schedule of vertical strips. In conventional tillage, the field was ploughed with a disc plough to break the hard pan followed by a cultivator and the rotavator to get a fine seed bed whereas, in farmer's practice, the field was ploughed with a cultivator followed by a rotavator. Basal application of organic and inorganic sources was done as per the treatment schedule. The length and width of each plot were 7m x 5m respectively. To reduce the impact of different treatments, each plot was separated by a buffer channel with a distance of 60 cm. Little millet (ATL 1) seeds were sown by line sowing method with an inter-row distance of 25cm and intra-row distance of 10cm respectively.

The initial and final soil samples before sowing and harvest of the crop were analysed for pH, EC, available N, P_2O_5, K_2O as per the standard procedures. Data on growth parameters *viz*., plant height, leaf area index, dry matter production, number of tillers, internode tillers, internode length, growth indices and yield attributes *viz*., number of productive tillers, panicle length, panicle weight of little millet were observed.

2.4. Statistical analysis

Statistical analyses of data were carried out according to the strip plot design. Data were analysed in R Studio as per methods suggested by [8]. All the parameters were subjected to analysis of variance and least significant difference at probability level ≤ 0.05.

3. Results and discussion

3.1. Effect of tillage and nutrient management on growth parameters

The growth parameters of little millet were also significantly influenced by tillage and nutrient management practices. Plant height, leaf area index, number of tillers, and internode tillers were significantly higher in conventional tillage (Disc plough+ Cultivator + Rotovator) followed by farmer's practice (Cultivator + Rotovator). Among different nutrient management practices, application of enriched vermicompost @ 1t ha^{-1} with foliar spray of 3% *Panchagavya* on 30th DAS+ 5% egg amino acid on 45th DAS (N_4) recorded higher plant height, leaf area index, number of tillers, internode tillers, internode length followed by enriched farm yard manure @ 1t ha^{-1} with foliar spray of 3% *Panchagavya* on 30th DAS +5% egg amino acid on 45th DAS (N_2). The result of the data analysis was given in Table 3. Similarly, the number of internode tillers and internode length were also significantly increased under the interaction effect of tillage and nutrient management given in Fig.1 and Fig.2. This might be due to higher availability of nutrients from the soil and increased cell growth due to foliar application. These results are in accordance with the findings of [33] and [13].

3.1.1. Plant height and number of tillers

Among different nutrient management practices, plots treated with enriched vermicompost @ 1t ha^{-1} with foliar spray of 3% *Panchagavya* on 30th DAS + 5% egg amino acid on 45th DAS (N_4) have recorded higher plant height (Table 3) compared to other treatments. This might be due to the higher nitrogen availability from enriched vermicompost which tends to increase in nutrient content by enrichment process results well in a multiplication of soil microbes that could convert organic to the inorganic available form of nutrients for plant growth and development. The results are in conformity with [3]. Availability of small quantities of macronutrients, micronutrients, and growth promoting substances in addition to the presence of a huge beneficial microbial population in *Panchagavya* and egg amino acid as foliar spray triggers the necessary plant growth. Quick absorption and assimilation of essential nutrients and amino acids lead to improve metabolic activities and cell division of plants resulting in higher plant height and more tillers. Similar findings were confirmed by [19] and [24].

3.1.2. Leaf area index (LAI)

The treatment (N_4) resulted in higher values of LAI than other treatments. This might be due to higher nutrient availability at critical stages increases leaf number, and leaf size which leads to better uptake of nutrients resulting in increased LAI with better photosynthesis activity and accumulation [21]. Moreover, liquid bioenhancer influences the nitrogen uptake to produce larger cells with thinner cell walls and contribution in cell division and cell elongation, which promoted vegetative growth and improved metabolic and photosynthetic activity. The LAI was significantly higher in plots applied with enriched vermicompost @ 1 t ha^{-1} along with a foliar spray of 3% *Panchagavya* on 30th DAS and 5% egg amino acid on 45th DAS (N_4). Enhanced availability of nitrogen from enriched organic sources could have facilitated for the increased LAI at the peak flowering stage as evidenced from the research work of [9]. The lowest Leaf area index was obtained in the control plot (N_7) under both the tillage system (Table 3).

3.1.3. Dry matter production

Dry matter production was not varied in significantly with tillage systems. Under both tillage practices, the mean higher dry matter production was observed in the treatment plot of application of enriched vermicompost along with a foliar spray of 3% *Panchagavya*on 30th DAS and 5% egg amino acid on 45th DAS recorded significantly higher dry matter production during various growth stages found that at 30 DAS (2356 kg ha^{-1}), 60 DAS (4418 kg ha^{-1}) and at harvest (6346 kg ha^{-1}). The mean lower dry matter production of 1803, 3283, and 4566 kg ha^{-1} was obtained with control treatment (N_7) at 30 DAS, 60 DAS, and at harvest respectively (Fig.3). Presence of essential nutrients, growth enzymes, and organic acids enhances the metabolic and photosynthetic activity of plant which helps in uptake more nutrients from soil cause there–by accumulation of more carbohydrates and higher dry matter. This is in conformity to the result of [38] and [7]. The interaction effect of the tillage system with organic sources resulted in higher drymatter production might be due to the addition of nutrients in the soil as well as foliar supplementation which leads to an increase in the solubilizing effect on the fixed form of other nutrients.

This result corroborates to the findings of [14].

4. Effect of tillage and nutrient management on crop growth indices

4.1. Leaf Area Duration (LAD)

LAD takes into account, both the duration and extent of photosynthetic tissue of the crop canopy. [18] integrated the LAI with time called as Leaf Area Duration. The LAD is expressed in days.

$LAD = ((L_1 + L_2) / 2) \times (t_2 - t_1)$

Where, L_1 = LAI at the first stage, L_2 = LAI at the second stage, $(t_2 - t_1)$ = Time interval in days

The results of the data analysis showed that LAD was affected by the interaction between tillage and nutrient management (Table 4). The highest LAD values between 30-60 DAS and 60 DAS- at harvest were obtained from the plot treated with the application of enriched vermicompost followed by foliar application of *Panchagavya* and egg amino acid (N_4) under both the tillage system. This might be due to the synergistic effect enhanced by nutrients through the soil and foliage encouraging physiological activity of the plants.

4.2. Crop Growth Rate (CGR)

CGR is the rate of daily increment in the accumulation of dry matter by the crop of a particular area. This method was suggested by Watson (1956).

$CGR = (W_2 - W_1) / \rho (t_2 - t_1)$

Where, W_1 and W_2 are whole plants dry weight at time t_1 and t_2; ρ is the ground area on which W_1 and W_2 are recorded, respectively.

CGR was markedly influenced by different tillage and nutrient management practices at successive growth intervals. Higher CGR may be due to higher production of dry matter owing to greater LAI and higher light interception. Similar findings were reported by [22] and Ronanki *et al*. (2018). In general, the CGR values were found lowest between 30 to 60 days, increased gradually and attained the highest values between 60 to harvest (Table 4).

4.3. Relative Growth Rate (RGR)

RGR is a measure used to quantify the speed of plant growth. It is measured as the mass increase per above ground biomass per day. It is expressed as mg/g/day. It was suggested by [35] and calculated with the help of the following formula

$RGR = (\log_e W_2 - \log_e W_1) / t_2 - t_1$

Where, W_1 = dry matter production per unit area at time t_1; W_2 = dry matter production per unit area at time t_2; t_1 = days to first sampling; t_2 = days to second sampling

The highest mean RGR was observed under conventional tillage when compared to the farmer's practices was found to be non-significant. The result of the data analysis was given in Table 4. The highest RGR was resulted in the treatment N_4 mainly due to higher dry matter production accumulated in the plants. This might be due to higher translocation and nutrient metabolization ultimately increasing the cell division and multiplication there-by accumulating more amount of dry matter in the plants which resulted in higher growth and development. These findings are in consonance with [4].

4.4. Absolute Growth Rate (AGR)

The absolute growth rate was computed by Radford (1967) and expressed as g/plant/day. It was calculated with the help of the following formula.

$AGR = W_2 - W_1 / t_2 - t_1$

Where, W_2 and W_1 are dry matter weight per plant at t_2 and t_1 times

AGR was not significantly influenced by tillage at various growth intervals. The highest absolute growth rate was observed in the treatment plot (N_4) between 60 DAS to harvest stage under tillage and nutrient management practices whereas the lowest absolute growth rate was noticed in the control treatment (N_7). The result of the data analysis was given in Table 4.

5. Effect of tillage and nutrient management on root length

Growth of root length across the soil profile was significantly influenced by the tillage systems (Fig.4). Under conventional tillage, increased root length during 30 DAS (15.36 cm), 60 DAS (21.04 cm) and at harvest (21.53) was observed and given in Fig.4. The mean minimum root length was obtained with control treatment (N_7) at 30 DAS, 60 DAS and at harvest respectively. The probable reason for maximum root length under a conventional tillage system could be the favorable integrated effect on soil physical properties that enhanced the root growth with greater uptake of water and nutrients. Besides water and nutrient uptake, roots can markedly influence the activities of growth and yield attributes in little millet. This is in accordance with earlier findings of [23] and [37].

6. Effect of tillage and nutrient management on yield attributes

The yield attributes *viz*., number of productive tillers per hill, panicle length (cm), and panicle weight (g) not significantly varied under the two tillage practices.The interaction between tillage and nutrient management was found to be significant. Application of enriched vermicompost @ 1 tha^{-1} followed by foliar application of *Panchagavya* 3% on 30^{th} DAS (active tillering stage) and 5% egg amino acid on 45^{th} DAS (flowering stage) increased the yield attributes and it remained on par with enriched farm yard manure @ 1 t ha^{-1} along with a foliar spray of 3% *Panchagavya* on 30^{th} DAS and 5% egg amino acid on 45^{th} DAS (N_7) (Table 5). These increases in yield attributes by enriched vermicompost are mainly influenced due to prolonged availability of nutrients and also higher nutrient uptake comparable with vermicompost. Similar trends were in conformity with the earlier findings of [28] and [32].

6.1. Number of Productive Tillers

Maximum productive tillers per hill were obtained from the conventional tillage plot applied with enriched vermicompost @ 1 t ha^{-1} followed by foliar spray of 3% *Panchagavya* on 30^{th} DAS and 5% egg amino acid on 45^{th} DAS (N_4). The lowest productive tillers were noted in the control plot (N_7) under both tillage practices as reported in Table 5. This might be due to the easy transfer of nutrients from the soil and high photosynthetic activity through foliar application to plants being the reason for the enhancement of productive tillers. Similarly, plants absorb more nutrients from the soil and transform it into a useful sink. These results were in accordance with [27]. The lowest productive tillers recorded in the control treatment (N_7) could be due to the non-application of supplements to supply required nutrients to the plant's resulting in reduced tiller production and also having a negative impact on yield attributes of little millet.

6.2. Panicle length and panicle weight

Panicle length (cm) and panicle weight (g) were not significantly influenced by two tillage practices. The application of organic nutrient sources regulates transpiration capacity from source to sink. This might be due to the luxuriant availability of nutrients through foliar spraying during the peak flowering stage which stimulates the translocation of assimilates to sink. The results of the data analysis were given in Table 5.

Conclusion

It is possible to draw the conclusion from this research that the tillage system and organic nutrient management has agreater impact on the productivity of little millet compared to the farmer's practice. Based on the evidence, it has been assessed that a conventional tillage system with application of enriched vermicompost @ 1 t ha^{-1} followed by foliar spray of 3% *Panchagavya* on 30^{th} DAS and 5% egg amino acid on 45^{th} DAS led to enhance growth characters, crop growth indices and yield attributes of little millet. Therefore, conventional tillage and nutrient management with foliar supplementation will be a viable and sustainable option for better organic cultivation meanwhile resulting in more efficient use of organic resources.

Future prospects

The research evidences and literatures clearly showed that enough research was not carried out on millets. To meet the present demand of millet productivity and importance of the crop, research work should be focuses in the following directions.

- ❖ Future research will be carried out to understand the different tillage practices on soil physio-chemical properties, nutrient budgeting and rhizosphere studies in nutri-cereals production.
- ❖ To study the effect of different enriched organic manures on plant-soil- microbe interaction and quality of small millets.
- ❖ Studies on the response of different micronutrient and its management over millet nutritional improvement.

- Research on suitable cropping system, intercropping, weed management and appropriate water requirement studies to improve the productivity of small millet.

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Conflicts of interest
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Table 3. Effect of tillage and nutrient management on growth parameters

Treatments	Plant height (cm)			Leaf area index			Number of tillers /plant		
	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest
Tillage practices									
T_1 - Conventional tillage (Disc plough + Cultivator + Rotovator)	42.11	99.87	105.98	1.20	3.73	2.34	7.48	9.88	10.25
T_2 – Farmer's practices (Cultivator + Rotovator)	41.40	94.43	98.28	1.09	2.88	1.94	7.19	8.47	8.97
SEd	2.03	4.35	5.34	0.35	0.24	0.08	0.50	0.65	0.19
LSD(0.05)	NS	9.44	11.58	0.75	0.51	0.18	NS	1.4	0.42
Nutrient Management practices									
N_1-FYM @ 12.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30^{th} DAS + 3% vermiwash on 45^{th} DAS	42.13	97.42	103.30	1.23	3.62	2.25	7.53	9.61	9.63
N_2-EFYM @ $1tha^{-1}$ + Foliar spray of 3% *Panchagavya* on 30^{th} DAS +5% egg amino acid on 45^{th} DAS	42.84	99.42	105.90	1.26	3.82	2.33	7.77	9.79	9.80
N_3-VC @ 2.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30^{th} DAS + 3% vermiwash on 45^{th} DAS	42.03	96.02	100.94	1.13	3.32	2.07	7.32	9.43	9.60
N_4-EVC @ $1tha^{-1}$ + Foliar spray of 3% *Panchagavya* on 30^{th} DAS+ 5% egg amino acid on 45^{th} DAS	43.13	103.11	112.59	1.40	3.94	2.55	7.93	10.52	10.80
N_5-GM @ 2.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30^{th} DAS + 5% vermiwash on 45^{th} DAS	41.60	95.83	98.92	1.06	3.12	2.01	7.24	9.06	9.46
N_6-RDF of NPK fertilizers + Foliar spray of water on 30^{th} & 45^{th} DAS	41.39	94.41	97.23	1.00	2.85	1.97	6.87	8.32	9.28
N_7-Absolute control.	39.16	93.86	96.03	0.95	2.45	1.79	6.66	7.52	8.70
SEd	1.44	2.49	3.51	0.01	0.24	0.12	0.39	0.43	0.34
LSD(0.05)	NS	5.41	7.62	0.11	0.53	0.26	NS	0.93	0.74
Interaction effect									
T at N SEd	1.06	1.65	3.87	0.10	0.25	0.12	0.57	0.64	0.29
LSD (0.05)	NS	NS	8.40	NS	NS	NS	NS	1.39	0.63
N at T SEd	1.09	1.68	3.90	0.12	0.27	0.14	0.59	0.67	0.31
LSD (0.05)	NS	NS	8.46	NS	NS	NS	NS	1.45	0.67

Table 4. Effect of tillage and nutrient management practices on crop growth indices

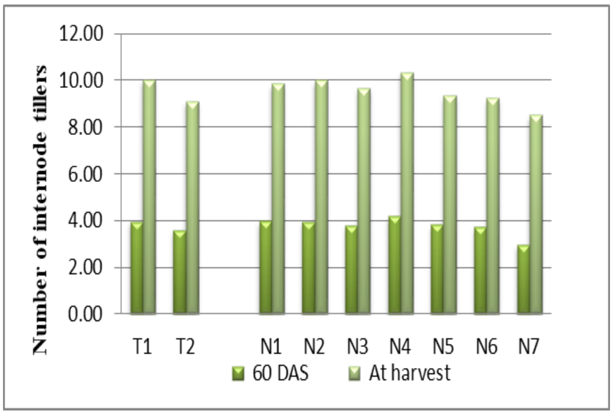
Treatments	LAD (days)		CGR ($g/cm^2/day$)		RGR (mg/g/day)		AGR (g/plant/day)	
	30-60 DAS	60 DAS - At harvest	30-60 DAS	60 DAS - At harvest	30-60 DAS	60 DAS - At harvest	30-60 DAS	60 DAS - At harvest
Tillage practices								
T_1-Conventional tillage (Disc plough + Cultivator + Rotovator)	74.03	91.07	0.72	0.75	9.38	5.83	0.2	0.21
T_2 -Farmer's practices (Cultivator + Rotovator)	59.61	72.30	0.61	0.63	8.43	5.43	0.17	0.17
SEd	3.12	4.76	0.026	0.027	0.210	0.022	0.007	0.008
LSD (0.05)	6.76	10.22	0.056	0.059	NS	NS	0.016	0.017
Nutrient Management practices								
N_1-FYM @ 12.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30^{th} DAS + 3% vermiwash on 45^{th} DAS	72.88	88.16	0.71	0.73	9.15	5.71	0.20	0.20
N_2-EFYM @ $1tha^{-1}$ + Foliar spray of 3% *Panchagavya* on 30^{th} DAS +5% egg amino acid on 45^{th} DAS	76.23	92.26	0.73	0.75	9.23	5.72	0.20	0.21

N_3-VC @ 2.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30th DAS + 3% vermiwash on 45th DAS	66.75	80.94	0.69	0.72	8.98	5.69	0.19	0.20
N_4-EVC @ 1tha^{-1} + Foliar spray of 3% *Panchagavya* on 30th DAS+ 5% egg amino acid on 45th DAS	80.25	97.43	0.79	0.82	9.33	5.78	0.22	0.23
N_5-GM @ 2.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30th DAS + 5% vermiwash on 45th DAS	62.81	77.07	0.62	0.65	8.60	5.56	0.17	0.18
N_6-RDF of NPK fertilizers + Foliar spray of water on 30th & 45th DAS	57.86	72.33	0.58	0.61	8.54	5.50	0.16	0.17
N_7-Absolute control.	50.98	63.62	0.53	0.54	8.50	5.46	0.15	0.15
SEd	3.53	4.20	0.029	0.03	0.370	0.290	0.008	0.008
LSD(0.05)	7.67	9.11	0.064	0.065	0.81	NS	0.018	0.0181
Interaction effect								
T at N SEd	4.11	4.76	0.037	0.046	0.38	0.42	0.010	0.012
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
N at T SEd	4.15	4.53	0.041	0.047	0.41	0.43	0.011	0.013
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Effect of tillage and nutrient management on yield attributes

Treatments	Number of productive tillers/hill	Panicle length (cm)	Panicle weight (g)
Tillage practices			
T_1 - Conventional tillage (Disc plough + Cultivator + Rotovator)	7.91	26.85	2.04
T_2 – Farmer's practices (Cultivator + Rotovator)	7.27	26.37	1.93
SEd	0.24	0.48	0.03
LSD(0.05)	0.53	1.05	0.06
Nutrient Management practices			
N_1-FYM @ 12.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30th DAS + 3% vermiwash on 45th DAS	7.90	26.70	2.02
N_2-EFYM @ 1tha^{-1} + Foliar spray of 3% *Panchagavya* on 30th DAS +5% egg amino acid on 45th DAS	7.95	26.91	2.04
N_3-VC @ 2.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30th DAS + 3% vermiwash on 45th DAS	7.78	26.68	2.00
N_4-EVC @ 1tha^{-1} + Foliar spray of 3% *Panchagavya* on 30th DAS+ 5% egg amino acid on 45th DAS	8.15	27.30	2.08
N_5-GM @ 2.5 tha^{-1} + Foliar spray of 3% *Panchagavya* on 30th DAS + 5% vermiwash on 45th DAS	7.53	26.61	1.98
N_6-RDF of NPK fertilizers + Foliar spray of water on 30th & 45th DAS	7.02	26.26	1.93
N_7-Absolute control.	6.81	25.79	1.87
SEd	0.29	0.49	0.04
LSD(0.05)	0.64	1.06	0.09
Interaction effect			
T at N SEd	0.37	0.41	0.05
LSD(0.05)	0.79	0.88	NS
N at T SEd	0.39	0.43	0.07
LSD(0.05)	0.85	0.93	NS

Fig.1. Effect of tillage and nutrient management on internode tillers	**Fig.2. Effect of tillage and nutrient management on internode length**



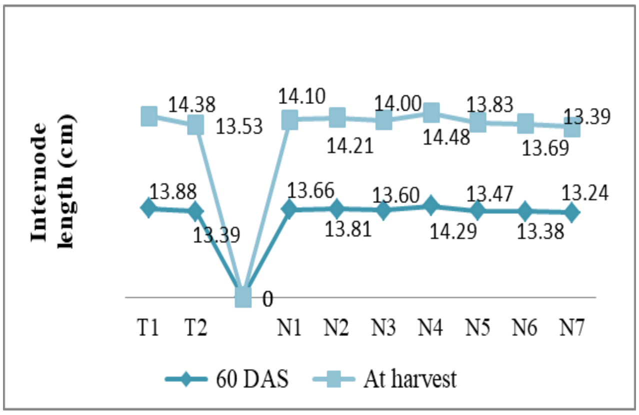


Fig.3. Effect of tillage and nutrient management on dry matter production kg ha^{-1}	**Fig.4. Effect of tillage and nutrient management on root length (cm)**