

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.706.050>

Influence of Nutrient Management Practices on Growth and Yield of Pearl Millet in *Melia dubia* Based Agri-Silvi System

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ABSTRACT

A field experiment was conducted during *Kharif*, 2017 consisting of integrated nutrient management practices in Pearl millet inter cropped in *Melia dubia* based Agri-silvi system on sandy loam soils of Agroforestry Research Block, AICRP on Agroforestry, Rajendranagar, Hyderabad. The experiment was laid out in Randomized block design with three replication and eight treatments *viz.*, T₁- Control (no fertilizer and manure), T₂-100% RDF (80-40-30 NPK kg ha⁻¹) through normal urea, T₃-100% RDF through neem coated urea, T₄-75% RD N + 25% N Poultry manure, T₅-75% RD N + 25% N FYM, T₆-75% RD N + Pongamia green leaf manure @ 10 t ha⁻¹, T₇-75% RD N + *Azotobacter* @ 500 g ha⁻¹, T₈-Sole crop without trees (100% RDF). Results of the experiment revealed that, sole crop without trees (T₈) recorded significantly higher plant height and dry matter accumulation followed by 100% RDF through neem coated urea (T₃) and 75% RD N + Pongamia green leaf manure 10 t ha⁻¹ (T₆). Leaf area per plant is highest with T₈ but was on par with T₆ and significantly superior to rest of the treatments. SPAD meter readings were found highest with T₃ which was on par with T₈ and significantly superior to all other treatments. Grain yield and stover yield were found significantly highest with T₈ followed by T₃ and T₆.

Keywords

Pearl millet, *Melia dubia*, Agroforestry, Nutrient management

Article Info

Accepted:

02 May 2018

Available Online:

10 June 2018

Introduction

Pearl millet (*Pennisetum glaucum* L.), the world's hardiest warm season cereal crop (Reddy *et al.*, 2012). Globally it ranks sixth after rice, wheat, maize, barley and sorghum in terms of area (Khairwal *et al.*, 2007) and share 42% of total world production (Ramesh *et al.*, 2006). In India, it is the fifth most important cereal grain crop next to rice, wheat, maize and sorghum. Pearl millet is an indispensable arid and semi-arid crop of India (Ramesh *et al.*, 2006) cultivated as dual

purpose (food and feed) crop in over 7.12 m ha ranking fourth among total cereals (Agricultural Statistics at a Glance, 2016). The recent spurt in prices of wheat, rice and maize and growing demand for non-food uses (cattle and poultry feed, alcohol and starch industries), pearl millet became cheaper alternative sources (Reddy *et al.*, 2013). Further, the nutritional value of this crop offers much scope to development of value added products in new health conscious consumer segments (Yadav *et al.*, 2011) as it contains more fibre and is good for diabetic

and heart patients. Increase in productivity of pearl millet is likely to have high socioeconomic impact as it is cultivated by small and marginal farmers. Importance of the pearl millet in low cost agriculture of small and marginal farmers was highlighted during annual pearl millet workshop held at Junagadh Agricultural University on 23 March 2013 (ICAR 2013). In the workshop, pearl millet was described as a future crop under climate change scenario. Tolerance to drought and heat and better adaptability of pearl millet to climate change has been reported from African Sahel (CO₂ Science, 2011).

Agricultural practices have major impact on global carbon cycle and leading to increase in the global temperature during 20th century by $0.6 \pm 0.2^{\circ}\text{C}$ at an average rate of increase of 0.17°C per decade since 1950 (Dubey and Lal, 2009). Hence, crop production practices which leads to lesser emissions are more desirable for sustainability and environmental safety from any production system. Urea formulations designed to synchronize N release with plant needs, optimum N supply to crops, proper animal and crop residue management, use of controlled release fertilizers, nitrification inhibitors and proper water management are being assessed to reduce emissions (Asgedom *et al.*, 2014). Use of chemical fertilizers like neem coated urea inhibits the nitrification rate which is intended to improve the efficiency or uptake of N by plants and reduces NO₃⁻ and N₂O release into the environment (Hala *et al.*, 2014).

Increased use of fertilizers without organic recycling has not only aggravated multi-nutrient deficiencies in soil-plant-system but also detrimental to soil health and has created environmental pollution. Judicious combination of organic manures and chemical fertilizers depending upon the availability, nature and properties of the soil and crops to be grown would not only maximize the crop

production and improve the quality of agricultural produces but would also help in maintaining the soil fertility (Madhavi Lata *et al.*, 2014). Nutrient management, recycling, soil quality improvement and land productivity as a holistic approach is good efficient indication which will be achieved through cropping system studies rather than single season crop. There is a great risk of growing food grains in degraded and cultivable wastelands.

Organic amendments such as FYM are the major source of organic manure. Poultry manure contains higher content of N which is readily available to crops and also possess various micro-nutrients (Pratap *et al.*, 2008). Pongamia green leaf contains higher content of easily mineralizable N, important for improvement of soil physical properties and is a good source of nutrients for low fertility soils under dryland agriculture. *Azotobacter* is a free-living nitrogen fixing bacteria which fixes about 20-40 kg N ha⁻¹ year⁻¹ besides producing growth promoting substances (Ranveer Singh *et al.*, 2013).

Due to global warming there was change in climate and impact is moderate to very serious in many countries in general and particular in African and Asian continents. To address climate change thoroughly, there is a need to bring the trees to the forefront and support farmers to intensify and diversify their agroforests (Aariff Khan and Krishna, 2016). Sequestering carbon in tree biomass by way of integrating trees into landscapes as agroforestry, forestry and plantations is a cost-effective climate change mitigation strategy (Josep *et al.*, 2008 and Prasad *et al.*, 2012). Suitably selected trees in an agroforestry system enhance the system productivity and act as sink for atmospheric carbon. The system as a whole contributes to mitigate climate change with secondary benefits of food security, increased farm income, restored

biodiversity, maintained watershed hydrology and improved soil health and people livelihood (Roy and Tewari, 2012 and Singh *et al.*, 2007). Due to harsh and fragile ecology of arid and semi-arid region, required to identify or develop economic and viable land use system. In such situation, agri-silvi system, particularly during initial 5-6 years have ample scope to exploit the interspaces of the trees for growing arable crops.

Among different tree species, *Melia dubia* has been screened as one of the best alternate of pulpwood species (Parthiban *et al.*, 2009). It belongs to the family Meliaceae, commercially known as Malabar Neem and is locally called as Malabar Vepa. It is a large deciduous and fast growing tree with wide spreading branches, straight and tall bole. *M. dubia* with its multi-various uses like pulpwood, timber, fuel wood and plywood can fit as a suitable species for agro and farm forestry plantation programme (Saravanan *et al.*, 2013).

With the present scenario of environment pollution which is detrimental to the sustainability there is an urgent need for adoption of farming practice which ensures soil health, human health, animal health and environmental health. Keeping this background in mind, an experiment was conducted to assess the influence of nutrient management practices on growth and yield of pearl millet in *Melia dubia* based agri-silvi System

Materials and Methods

Field experiment was conducted during *kharif*, 2017 at Agroforestry research block, AICRP on Agroforestry, Rajendranagar, Hyderabad which is geographically situated at 17°19' N latitude, 78°28' E longitude and at an altitude of 555 m above mean sea level which is situated in the Southern Telangana Agro-

climatic zone of Telangana state. The experimental soil was sandy loam texture with pH (6.23), EC (0.135 dS m⁻¹) and OC (0.77 %). The soil was medium in available nitrogen (287.6 kg ha⁻¹), low in available phosphorus (41.31 kg ha⁻¹) and medium in available potassium (214.0 kg ha⁻¹). The experiment was laid out in a randomized block design and replicated thrice, treatments comprised of T₁ Control (no fertilizer and manure), T₂ 100% RDF through normal urea, T₃ 100% RDF through neem coated urea, T₄ 75% RD N + 25% N Poultry manure, T₅ 75% RD N + 25% N FYM, T₆ 75% RD N + Pongamia green leaf manure @ 10 t ha⁻¹, T₇ 75% RD N + *Azotobacter* @ 500 g ha⁻¹, T₈ Sole crop without trees (100% RDF).

Pearl millet was intercropped in *Melia dubia* of six years old wherein, the trees are at a spacing of 5 m x 4 m. Pearl millet was sown on 4th July, 2017 and harvested on 6th October. During the growing season, the mean weekly maximum, minimum temperature, relative humidity, sunshine hrs day⁻¹ and rainfall were 30.3°C, 21.9°C, 90%, 66.9%, 4.7 hrs dy⁻¹ and 6.6 mm in 0.4 rainy days. Pearl millet variety PHB-3 was planted at a spacing of 45 cm x 15 cm using seed rate of 5 kg ha⁻¹. The quantity of organic manures was applied as per the treatments. The N, P and K were applied through normal urea, neem coated urea, SSP and MOP as per the treatments. Entire dose of phosphate and potash and half dose of N were incorporated into the soil basally at the time of final land preparation. The remaining half N was applied as split application at 30 DAS. *Azotobacter* @ 500 g ha⁻¹ was applied as seed treatment to the treatment specified.

Plant samples of pearl millet from gross plot were collected to record dry matter production at 30, 45, 60 DAS and at harvest. To determine grain yield, ear heads from the net plot were harvested and sun dried. Threshing was done by beating the ear heads with sticks.

The separated grains were cleaned, dried in sun to bring down the moisture content to 12%. To determine stover yield, stalks were cut at ground level and weighed after sun drying. The data were subjected to analysis of variance procedures as outlined for randomized block design factorial concept (Gomez and Gomez, 1984). Statistically significance was tested by F-value at 5 % level of probability and critical difference was worked out where ever the effect were significant.

Results and Discussion

Plant height

The influence of different nutrient management practices on plant height of pearl millet was significant in different treatments (Table 1). As the crop advanced from 30 DAS to harvest, the plant height increased progressively and showed a marginal increase at harvest. In all stages of crop growth, significantly higher plant height was recorded in T₈ (sole crop without trees) (209.8 cm) at harvest over all treatments followed by T₃ (100% RDF through neem coated urea) (194.8 cm) which is on par with T₆ (75% RD N + PGLM 10 t ha⁻¹) (183.2 cm).

The percentage increase in plant height at harvest with sole crop, 100% RDF through neem coated urea, 75% RD N + PGLM 10 t ha⁻¹ and 100% RDF through normal urea over control was 72.25%, 59.93%, 50.41% and 39.65% respectively. Among other integrated nutrient sources, i.e., T₄, T₅ and T₇, the percentage increase over control was 35.38%, 30.21% and 11.82% respectively.

During initial stages of crop, nutrients are readily available through inorganic fertilizers, whereas during later stages of crop the nutrients are supplied by both inorganic as well as organic forms due to decomposition,

thus making higher availability of nutrients which resulted in better root development and high photosynthetic rate. Moreover, the nutrient concentration of pongamia green leaf manure is higher when compared to poultry manure and FYM and hence higher plant height was recorded. The increased availability of nutrients in the soil through mineralization of organic sources could have triggered cell elongation and multiplication resulting in high growth rate of shoots in turn plant height of pearl millet over control. These results were in agreement with the findings of Amit Kumar *et al.*, (2017), Giribabu *et al.*, (2010) and Dahiya *et al.*, (2008).

Dry matter production

The dry matter production increased significantly at 30, 45, 60 DAS and harvest in all the treatments. Higher and continuous nutrient availability from sources of nitrogen and phosphorus upto the crop maturity improved the photosynthetic activities of the plant and caused increase in dry matter accumulation and also might be due to better translocation of carbohydrates and their utilization for the production of more leaves with increase in age and nutrient application and the cumulative effect of progressive increase in growth parameters. Similar findings were reported by Parihar *et al.*, (2012) and Parashar *et al.*, (2011) (Table 2).

T₈ treatment recorded significantly higher dry matter production at harvest (6178 kg ha⁻¹) followed by T₃ treatment (5629 kg ha⁻¹) and T₆ treatment (5133 kg ha⁻¹) whereas T₂ (4642 kg ha⁻¹) and T₃ (5629 kg ha⁻¹) treatments are on par with each other. This might be due to nitrogen contribution from pongamia leaves and inorganic nitrogen supplied through fertilizers resulting in more number of tillers, maximum leaf area and high photosynthesis leading to accumulation of higher dry matter which reflected in stem length and thickness

that lead to increased biomass either fresh or dry (Bheemaiah and Subrahmanyam, 2004). Balanced nutrition due to release of macro and micro nutrients with application of inorganics and organics under favourable environment might have helped in higher uptake of nutrients. This accelerated the growth of new tissues and development of new shoots that have ultimately increased the dry matter accumulation (Ramdev Togas *et al.*, 2017).

75% RD N + 25% N FYM and 75% RD N + *Azotobacter* were on par with each other and significantly superior over control at all growth stages. The better response of crop to bio fertilizer over control might be attributed to increased nitrogen availability by fixing appreciable amount of molecular nitrogen and made available for plant growth and synthesizes growth promoting enzymes like indole acetic acid (IAA), gibberellins, vitamins and also altered the microbial balance in the rhizosphere and produced metabolites that stimulated the plant development (Patel *et al.*, 2014).

At harvest, percentage increase in dry matter production with sole crop, 100% RDF through neem coated urea, 75% RD N + PGLM 10 t ha⁻¹, 100% RDF through normal urea and 75% RD N + 25% N poultry manure over control was 129%, 109%, 90%, 72% and 58% respectively.

Leaf area plant⁻¹

The increase in leaf area was more between 45-60 DAS, however, it was maximum at 60 DAS. The production of maximum leaf area at 60 DAS can be due to more light interception and presence of more number of active leaves at this stage.

The decrease in leaf area plant⁻¹ beyond 60 DAS may be attributed to the periodical shedding of mature and lower leaves.

Among different nitrogen sources in agri-silviculture system, highest leaf areaplant⁻¹ was observed with 75% RD N + PGLM 10 t ha⁻¹ at all growth stages which was significantly superior over 100% RDF through neem coated urea, 100% RDF through normal urea, 75% RD N + 25% N poultry manure followed by 75% RD N + 25% N FYM and 75% RD N + *Azotobacter* (Table 3).

There was 83.21%, 66.79%, 48.76%, 44.89% and 22.39% increase at harvest in sole crop, 75% RD N + PGLM 10 t ha⁻¹, 100% RDF through neem coated urea, 100% RDF through normal urea and 75% RD N + 25% N poultry manure respectively over control.

Leaf area recorded in control was significantly lower as compared to all other integrated nutrient management treatments.

The increase in leaf area in pongamia green leaf manure along with inorganic fertilizer treated plot over the rest of the treatments could be due to higher available nitrogen and organic carbon with the use of organics that caused increase in leaf size which ultimately resulted in higher leaf area plant⁻¹. The results were in agreement with the findings of Giribabu (2006) and Prasad *et al.*, (2010).

SPAD values

SPAD meter values indirectly indicate chlorophyll content in leaves in the crop canopy. SPAD values were found to increase gradually from 30 to 60 DAS and declined at harvest in all treatments (Table 4).

This might be due to gradual loss of plant growth promoter activity over a period of time as they are photolabile and relatively unstable *in vivo* as well as *in vitro* system and also because of decrease in applied soil nitrogen due to leaching or by volatilization loss according to Shekhar Kumar (2004).

Table.1 Plant height (cm) of pearl millet as influenced by nutrient management in *Melia dubia* based agri-silvi system

Treatments	30 DAS	45 DAS	60 DAS	Harvest
T ₁ Control	30.0	59.3	81.9	121.8
T ₂ 100% RDF through normal urea	45.6	92.4	122.4	170.1
T ₃ 100% RDF through neem coated urea	53.5	108.9	150.6	194.8
T ₄ 75% RD N + 25% N through Poultry manure	42.3	85.1	108.4	164.9
T ₅ 75% RD N + 25% N through FYM	38.9	78.4	94.5	158.6
T ₆ 75% RD N + PGLM @ 10 t ha ⁻¹	49.9	102.0	136.2	183.2
T ₇ 75% RD N + <i>Azotobacter</i> @ 500 g ha ⁻¹	35.9	73.6	91.0	136.2
T ₈ Sole crop without trees (80-40-30 NPK kg ha ⁻¹)	57.3	116.1	165.1	209.8
Mean	44.1	89.5	118.8	167.4
S.Em ±	1.22	2.26	4.18	4.16
CD (<i>P</i> =0.05)	3.69	6.85	12.66	12.61

Table.2 Dry matter production (kg ha⁻¹) of pearl millet as influenced by nutrient management in *Melia dubia* based agri-silvi system

Treatments	30 DAS	45 DAS	60 DAS	Harvest
T ₁ Control	345	1090	2761	2698
T ₂ 100% RDF through normal urea	577	1242	3841	4642
T ₃ 100% RDF through neem coated urea	768	1493	4786	5629
T ₄ 75% RD N + 25% N through Poultry manure	482	1225	3363	4258
T ₅ 75% RD N + 25% N through FYM	443	1213	3257	4151
T ₆ 75% RD N + PGLM @ 10 t ha ⁻¹	673	1370	4307	5133
T ₇ 75% RD N + <i>Azotobacter</i> @ 500 g ha ⁻¹	425	1175	3163	3353
T ₈ Sole crop without trees (80-40-30 NPK kg ha ⁻¹)	867	1655	5228	6178
Mean	573	1308	3838	4505
S.Em ±	31	41	148	162
CD (<i>P</i> =0.05)	95	126	448	491

Table.3 Leaf area plant⁻¹ (cm²) of pearl millet as influenced by nutrient management in *Melia dubia* based agri-silvi system

Treatments	30 DAS	45 DAS	60 DAS	Harvest
T ₁ Control	118.4	909.0	1262.3	1165.5
T ₂ 100% RDF through normal urea	176.8	1216.3	1926.0	1688.8
T ₃ 100% RDF through neem coated urea	192.2	1457.4	2009.3	1733.8
T ₄ 75% RD N + 25% N through Poultry manure	164.9	1186.0	1626.8	1426.5
T ₅ 75% RD N + 25% N through FYM	149.9	1273.5	1539.0	1422.0
T ₆ 75% RD N + PGLM @ 10 t ha ⁻¹	210.6	1582.1	2052.0	1944.0
T ₇ 75% RD N + <i>Azotobacter</i> @ 500 g ha ⁻¹	129.0	1239.8	1509.8	1388.3
T ₈ Sole crop without trees (80-40-30 NPK kg ha ⁻¹)	224.8	1703.3	2344.5	2135.3
Mean	170.8	1320.9	1783.7	1613.0
S.Em ±	5.07	39.51	62.31	67.22
CD (P=0.05)	15.36	119.85	189.00	203.90

Table.4 SPAD meter readings of pearl millet as influenced by nutrient management in *Melia dubia* based agri-silvi system

Treatments	30 DAS	45 DAS	60 DAS	Harvest
T ₁ Control	10.2	10.6	12.6	8.7
T ₂ 100% RDF through normal urea	23.9	25.5	32.4	27.5
T ₃ 100% RDF through neem coated urea	31.9	36.9	42.6	37.5
T ₄ 75% RD N + 25% N through Poultry manure	16.7	18.1	22.6	18.1
T ₅ 75% RD N + 25% N through FYM	20.5	21.8	27.7	22.9
T ₆ 75% RD N + PGLM @ 10 t ha ⁻¹	27.6	31.3	37.4	32.0
T ₇ 75% RD N + <i>Azotobacter</i> @ 500 g ha ⁻¹	13.7	14.1	17.7	13.6
T ₈ Sole crop without trees (80-40-30 NPK kg ha ⁻¹)	31.3	34.7	41.0	36.6
Mean	22.0	24.1	29.3	24.6
S.Em ±	1.11	1.06	1.54	1.44
CD (P=0.05)	3.37	3.21	4.68	4.37

Table.5 Grain and Stover yield of pearl millet as influenced by nutrient management in *Melia dubia* based agri-silvi system

Treatments	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
T ₁ Control	852	1903
T ₂ 100% RDF through normal urea	2340	4766
T ₃ 100% RDF through neem coated urea	2920	4791
T ₄ 75% RD N + 25% N through Poultry manure	1983	3952
T ₅ 75% RD N + 25% N through FYM	1443	3483
T ₆ 75% RD N + PGLM @ 10 t ha ⁻¹	2667	4636
T ₇ 75% RD N + <i>Azotobacter</i> @ 500 g ha ⁻¹	1187	3095
T ₈ Sole crop without trees (80-40-30 NPK kg ha ⁻¹)	3182	5150
Mean	2073	3977
S.Em ±	84	120
CD (P=0.05)	255	356

SPAD values at all growth stages were recorded higher in 100% RDF through neem coated urea on par with sole crop without trees and significantly superior over 75% RD N + PGLM 10 t ha⁻¹, 100% RDF through normal urea, 75% RD N + 25% N FYM, 75% RD N + 25% N poultry manure, 75% RD N + *Azotobacter* and control respectively.

Grain yield

It was revealed from the results (Table 5) that the highest grain yield was produced with sole crop without trees (3182 kg ha⁻¹) followed by 100% RDF through neem coated urea (2920 kg ha⁻¹) which was on par with 75% RD N + PGLM 10 t ha⁻¹ (2667 kg ha⁻¹) and significantly higher over rest of the treatments. The percentage increase in grain yield with sole crop, 100% RDF through neem coated urea and 75% RD N + PGLM 10 t ha⁻¹ over control was 273.47%, 243.89% and 213.03% respectively. Reduced yield in pearl millet intercropped in *Melia dubia* treatments compared to sole crop may be ascribed to competition for light, moisture and nutrients

with suppressing effect on crops and reduced solar radiation on crop canopy. Similar results were reported by Deswal and Nandal (2008), Prasad *et al.*, (2011) and Kumar *et al.*, (2013).

Increase of grain yield might also be due to the increased photosynthetic activity which resulted in higher accumulation of photosynthates and translocation to sink due to better source and sink channel which resulted in higher grain yield. These observations corroborate with those made by Patil and Shete (2008). The efficacy of inorganic fertilizer in improving grain yields was much pronounced when it was combined with organic manures (Pratap *et al.*, 2008). The variation in yield is attributed to improved growth and ear head characters that increased availability and absorption of nitrogen from soil which enhanced metabolic activities, translocation and synthesis of nutrients resulted in higher grain yield. The beneficial effect of nitrogen application through various sources on grain yield of pearl millet has also been reported by Meena *et al.*, (2003) and Hadda *et al.*, (2005).

Stover yield

Pearl millet as sole crop (5150 kg ha⁻¹) resulted significantly higher yields over rest of the treatments (Table 5). However, 100% RDF through neem coated urea (4791 kg ha⁻¹), 100% RDF through normal urea (4766 kg ha⁻¹) and 75% RD N + PGLM 10 t ha⁻¹ (4636 kg ha⁻¹) were found on par with each other and significantly superior over 75% RD N + 25% N poultry manure (3952 kg ha⁻¹), 75% RD N + 25% N FYM (3483 kg ha⁻¹) and 75% RD N + *Azotobacter* (3095 kg ha⁻¹).

The percentage increase in stover yield with sole crop, 100% RDF through neem coated urea, 100% RDF through normal urea, 75% RD N + PGLM 10 t ha⁻¹ and 75% RD N + 25% N poultry manure over control was 170.62%, 167.58%, 150.45%, 129.90% and 107.67% respectively.

Significant increase in yield with organics and inorganics together was attributed to build up of humus, organic carbon which improves the soil properties and increased availability of nutrients with addition of manure.

An increase in uptake of plant nutrients empowered the plant to manufacture more quantity of photosynthates resulting in more stover yield. Similar results were reported by Thumar *et al.*, (2016).

Acknowledgements

My earnest acknowledgment must go to my guides Dr. A. Madhavi Lata, Dr. M.A. Aariff Khan for their scholastic guidance, unceasing interest, valuable knowledge and technical advice. I wish my sincere thanks to K. Ramesh Reddy for his moral support, cooperation and kindness during my study and I thank all my teachers, friends and university for their cooperation and help during the research programme.

References

- Aariff Khan, M.A and Krishna, A. 2016. Agroforestry interventions for mitigating climate change in semi-arid regions of Telangana state, India. *International Journal of Current Research*. 8 (11): 40852-40855.
- Agricultural Statistics at a Glance. 2016. *Directorate of Economics and Statistics*. Ministry of Agriculture. Government of India.
- Amit Kumar., Mukesh Kumar and Naresh Kumar. 2017. Response of integrated nutrient management on growth and yield of pearl millet (*Pennisetum glaucum* L.)-wheat (*Triticum aestivum* L.) cropping system. *International Journal of Current Microbiology and Applied Sciences*. 6 (9): 1386-1390.
- Asgedom, H., Tenuta, M., Flaten, D.N., Gao, X and Kebreab, E. 2014. Nitrous oxide emissions from a clay soil receiving granular urea formulations and dairy manure. *Agronomy Journal*. 106: 732–744.
- Bheemaiah, G and Subrahmanyam, M.V.R. 2004. Growth and yield of groundnut intercropped with *Tamarindus indica* under different levels of fertility. *Indian Journal of Dryland Agricultural Research Development*. 19 (1): 94-96.
- CO₂ Science. 2011. Pearl millet adapting to climate change in the African Sahel; 7/13/2011, 14(28): 5 <http://connection.ebscohost.com/c/articles/63887766/pearl-milletadapting-climate-change-african-sahel>.
- Dahiya, D.S., Dahiya, S.S., Lathwal, O.P., Sharma, R and Sheoran, R.S. 2008. Integrated nutrient management in wheat under rice-wheat cropping system. *Haryana Journal of Agronomy*. 24 (1&2): 51-54.
- Deswal, A.K and Nandal, D.P.S. 2008. Growth and yield of wheat (*Triticum*

- aestivum*) under varying levels of irrigation and fertilizer in eucalyptus based agri-silviculture system. *Indian Journal of Agroforestry*. 10 (1): 10-14.
- Dubey, A and Lal, R. 2009. Carbon footprint and sustainability of agricultural production systems in Punjab, India and Ohio, USA. *J. Crop Improv.* 23: 332-350.
- Giribabu, B. 2006. Productivity and quality of finger millet (*Eleusine coracana* L. Gaertn.) cultivars as affected by nutrient management system. *M.Sc. (Ag) Thesis*. Acharya N.G Ranga Agricultural University.
- Giribabu, B., Lather, M.M., Chandra Sekhar, K and Sankara Rao, V. 2010. Effect of nutrient management system on productivity of finger millet (*Eleusine coracana* L. Gaertn.) cultivars under sandy soils. *The Andhra Agricultural Journal*. 57 (1): 4-6.
- Hadda, M.S., Aora, S and Khera, K.L. 2005. Evaluation of different soil and nutrient management practices on moisture conservation, growth and yield of maize in rainfed sub mountainous tract of Punjab. *J. Soil Wat. Conserv.* 4 (1&2): 101-105.
- Hala, Y., Jumadia, O., Muisa, Hartatia, A and Inubushib, K. 2014. Development of urea coated with neem (*Azadirachta indica*) to increase fertilizer efficiency and reduce greenhouse gases emission. *Jurnal Teknologi (Sciences & Engineering)*. 69 (5): 11-15.
- ICAR. 2013. Annual pearl millet work shop held at JAU, Junagarh (<http://www.icar.org.in/en/node/5888>-accessed on 3rd April 2013.)
- Josep, G.C and Michael, R. Raupach. 2008. Managing forests for climate change mitigation. *Science*. 320: 1456-1457.
- Khairwal, I.S, Rai, K.N., Diwakar, B., Sharma, Y.K., Rajpurohit, B.S., Nirwan, B and Bhattacharjee, R. 2007. Pearl Millet: Crop management and seed production manual. *ICRISAT*. p. 104.
- Kumar, A., Kumar, M., Nandal, D.P.S and Kaushik, N. 2013. Performance of wheat and mustard under *Eucalyptus tereticornis* based agri-silviculture system. *Range Management and Agroforestry*. 34 (2): 192-195.
- MadhaviLata, A., Srinivasa Raju, M., Joseph, B., Chandrasekhara Rao, P and Siva Sankar, A. 2014. Integrated nutrient management in Ashwagandha (*Withania somnifera* L.) under tree based cropping systems in drylands. *Indian Journal of Agroforestry*. 16 (1): 30-36.
- Meena, S., Harbir Singh, Hooda, R.S and Anil Khippal. 2003. Response of pearl millet (*Pennisetum glaucum*) composites to nitrogen under rainfed conditions. *Crop Research*. 26 (1): 67-70.
- Parashar, R., Anubha, U., Jasmeet, S., Diwedi, K.S and Khan, A. N. 2011. Morpho-physiological evaluation of *Andrographis paniculata* at different growth stages. *World Journal of Agricultural Sciences*. 7(2): 124-127.
- Parihar, C.M., Rana, K.S., Jat, M.L., Jat, S.L., Parihar, M.D., Kantwa, S.R., Singh, D.K and Sharma, S.2012. Carbon footprint and economic sustainability of pearl millet-mustard system under different tillage and nutrient management practices in moisture stress conditions. *African Journal of Microbiology Research*. 6 (23): 5052-5061.
- Parthiban, K.T., Bharathi, A.K.R., Seenivasan, K., Kamala and Rao, M.G. 2009. Integrating *Melia dubia* in agroforestry farms as an alternate pulpwood species. *APA News*. 34: 3-4.
- Patel, P.R., Patel, B.J., Vyas, K.G and Yadav, B.L. 2014. Effect of integrated nitrogen management and bio-fertilizer in *kharif*

- pearl millet (*Pennisetum glaucum* L.). *Advanced Research Journal of Crop Improvement*. 5 (2): 122-125.
- Patil, H.M and Shete, B.T. 2008. Integrated nutrient management in pigeonpea-pearl millet intercropping system under dryland conditions. *Journal of Maharashtra Agriculture University*. 33 (1): 119-120.
- Prasad, J., Karnakar, S., Kumar, R and Mishra, B. 2010. Influence of integrated nutrient management on yield and soil properties in maize-wheat cropping system in an alfisol of Jharkhand. *Journal of the Indian Society of Soil Science*. 58 (2): 200-204.
- Prasad, J.V.N.S., Korwar, G.R., Rao, K.V., Srinivas, K., Srinivasarao, C.H., Peddababu, B., Venkateswarulu, B., Rao, S.N and Kulkarni, H.D. 2011. On-farm evaluation of two fast growing trees for biomass production for industrial use in Andhra Pradesh, Southern India. *New Forests*. 42 (1): 51-61.
- Prasad, J.V.N.S., Srinivas, K., Srinivasa Rao, Ch., Ramesh, Ch., Venkatravamma, K. and Venkateswarlu, B. 2012. Biomass productivity and carbon stocks of farm forestry and agroforestry systems of leucaena and eucalyptus in Andhra Pradesh, India. *Current Science*. 103: 536-540.
- Pratap, R., Sharma, O.P and Yadav, G.L. 2008. Effect of integrated nutrient management under varying levels of zinc on pearl millet yield. *Annals of Arid Zone*. 47 (2): 197-199.
- Ramdev Togas., Yadav, L.R., Choudhary, S.L and Shisuvinahalli, G.V. 2017. Effect of integrated use of fertilizer and manures on growth, yield and quality of pearl millet. *International Journal of Current Microbiology and Applied Sciences*. 6 (8): 2510-2516.
- Ramesh, S., Santhi, P and Ponnuswamy, K. 2006. Photosynthetic attributes and grain yield of pearl millet [*Pennisetum glaucum* (L.) R. Br.] as influenced by the application of composted coir pith under rainfed conditions. *ActaAgron. Hung*. 54(1): 83-92.
- Ranveer Singh., Gupta, A.K., Tulasa Ram., Choudhary, G.L and Sheoran, A.C. 2013. Effect of integrated nitrogen management on transplanted pearl millet (*Pennisetum glaucum*) under rainfed condition. *Indian Journal of Agronomy*. 58 (1): 81-85.
- Reddy, A.A., Malik, D., Singh, I.P., Ardesna, N.J., Kundu, K.K. Rao, P., Gupta, S.K., Sharma, R and Gajanan. 2012. Demand and supply for pearl millet grain and fodder by 2020 in Western India. *ASI*. March, 2012. p. 635.
- Reddy, A.A., Rao, P.P., Yadav, O.P., Singh, I.P., Ardesna, N.J., Kundu, K.K., Gupta, S.K., Sharma, R., Sawargaonkar, G., Malik, D.P., Shyam, D.M and Reddy, K.S. 2013. Prospects for *kharif* (Rainy Season) and summer pearl millet in western India. Working paper series no. 36. Patancheru 502 324, Andhra Pradesh, India: *ICRISAT*. p. 24.
- Roy, M, M and Tewari, J.C. 2012. Agroforestry for climate resilient agriculture and livelihood in arid region of India. *Indian J. Agroforestry*. 14: 49-59.
- Saravanan, V., Parthiban, K.T., Kumar, P and Marimuthu, P. 2013. Wood characterization studies on *Melia dubia* cav. for pulp and paper industry at different age gradation. *Research Journal of Recent Sciences*. 2: 183-188.
- Shekhar Kumar. 2004. Effect of vermicompost and farmyard manure (FYM) on growth, development and oil composition of medicinal herb *krishnatulasi* (*Ocimum sanctum* Linn.

- Ocimum tenuiflorum*). M.Sc. (Ag) Thesis. Acharya N.G Ranga Agricultural University.
- Singh, G., Mutha, S and Bala, N. 2007. Effect of tree density on productivity of a *Prosopis cineraria* agroforestry system in North Western India. *Journal of Arid Environment*. 70 (1): 152-163.
- Thumar, C.M., Dudhat, M.S., Chaudhari, N.N., Hadiya, N.J and Ahir, N.B. 2016. Growth, yield attributes, yield and economics of summer pearl millet (*Pennisetum glaucum* L.) as influenced by integrated nutrient management. *International Journal of Agriculture Sciences*. 8 (59): 3344-3346.
- Yadav, O.P., Rai, K.N., Khairwal, I.S., Rajpurohit, B.S and Mahala, R.S. 2011. Breeding pearl millet for arid zone of northwestern India: constraints, opportunities and approaches. All India coordinated pearl millet improvement project, Jodhpur, India. p. 28.

How to cite this article:

Chandana, P., A. Madhavi Lata, M.A. Aariff Khan and Krishna, A. 2018. Influence of Nutrient Management Practices on Growth and Yield of Pearl Millet in *Melia dubia* Based Agri-Silvi System. *Int.J.Curr.Microbiol.App.Sci*. 7(06): 443-454.
doi: <https://doi.org/10.20546/ijcmas.2018.706.050>