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Yield and nutrient uptake of pearl millet (*Pennisetum glaucum*) as influenced by nutrient management practices under *Melia dubia* based Agri- silvi system

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Abstract
Field experiment was conducted during *kharif* 2017 and 2018 to study the effect of nutrient management practices on yield and nutrient uptake of pearl millet intercropped in *Melia dubia* (Agri-silvi system). The experiment consisted of eight treatments and laid out in randomised block design with three replications. The treatments are 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 through Poultry manure, T5 75% RD N + 25% N through 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 showed that sole crop of pearl millet recorded significantly higher grain yield, stover yield and nutrient uptake followed by 100% RDF through neem coated urea under *Melia dubia*. Among the integrated nutrient management treatments 75% RD N + Pongamia green leaf manure @ 10 t ha^{-1} registered higher yield and nutrient uptake of pearl millet compared to other treatments.

Keywords: Pearl millet, grain yield, straw yield and nutrient uptake

Introduction
Pearl millet (*Pennisetum glaucum*) is grown in arid and semi-arid regions of India. In India it is the fifth most important cereal grain crop next to rice, wheat, maize and sorghum. Globally, it ranks sixth in terms of area and shares 42 percent of total world production (Patil *et al.*, 2014) [6]. It is grown on large scale due to its drought escaping mechanism and lower water requirement as compared to other cereals like maize and sorghum (Meena and Gautam., 2005) [4]. Apart from this Pearl millet grain has good nutritional properties. Grain contains 11-19% protein, 60- 78% carbohydrates and 3.0-4.6% fat and also has good amount of phosphorous and iron (Reddy *et al.*, 2016) [8]. It is also used into livestock and poultry farm for feed, while pearl millet stover is a valuable livestock feed. The productivity of pearl millet is low because it is grown mostly on marginal and low fertile soils. Integration of chemical fertilizers, organic manures and bio fertilizers (INM) which is option to improve the soil fertility status on long term basis. At present situation, agroforestry is the best option to mitigate climate change. 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. *Melia dubia* is one of the best multipurpose tree species (timber and fodder). It is very fast growing and less shade effect on the intercrop. Keeping this in view, the present study was carried to know the influence of nutrient management practices on grain yield and nutrient uptake of pearl millet under *Melia dubia* based Agri- Silvi system.

Material and methods
Field experiment was conducted during *kharif*, 2017 and 2018 at Agroforestry research block, AICRP on Agroforestry, Rajendranagar, Hyderabad which is geographically situated at 17º19' N latitude, 78º28' 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 (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. The trees are at a spacing of 5m X 4m. Pearl millet (PHB hybrid) was sown at spacing of 45 cm X 15cm using seed rate of 5kg ha^{-1}. Fertilizers and organic manures were applied according to the treatments. Azotobacter @ 500 g ha^{-1} was applied in the form of seed treatment. Entire dose of phosphorus, potash and half dose of nitrogen were applied basally at the time of final land preparation. The remaining half of the nitrogen was applied at 30 DAS. Five plants in each plot were selected at random and tagged. These plants were used for recording biometric observations. The harvested produce from each net plot was threshed, sun dried, winnowed separately and the pearl millet grain yield was recorded at 14% moisture content and expressed in kg ha^{-1}. The data was statistically analyzed.

Results and discussion

The highest grain yield was recorded with sole crop (3150 kg ha^{-1}) followed by 100% RDF through neem coated urea (2901 kg ha^{-1}) which was on par with75% RD N + Pongamia green leaf manure @ 10 t ha^{-1} (2648 kg ha^{-1}) and significantly higher over 100% RDF through normal urea (2315kg ha^{-1}), 75% RD N + 25% N through poultry manure (1959 kg ha^{-1}), 75% RD N + 25% N through FYM (1421 kg ha^{-1}) and 75% RD N + *Azotobacter* (1170 kg ha^{-1}). The higher grain yield of pearl millet seemed to be the cumulative effect of yield attributes which was boosted by balanced nutrients supply. Similar results were reported by Barad *et al*. (2017) [1]. Increased 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 the results are in conformity with the findings of Divya *et al*. (2017) [2]. Reduced yield in pearl millet intercropped in *Melia dubia* treatments compared to sole crop may be due to competition for light, moisture and nutrients with suppressing effect on crops and reduced solar radiation on crop canopy. Similar results were reported by Prasad *et al*. (2011) [7] and Kumar *et al*. (2013) [3].

Pearl millet as sole crop (3841 kg ha^{-1}) resulted in significantly higher stover yield over rest of the treatments and it was on par with 100% RDF through neem coated urea (3561 kg ha^{-1}) and followed by 75% RD N Pongamia green leaf manure @10 t ha^{-1} (3165 kg ha^{-1}), 100% RDF through normal urea (3073 kg ha^{-1}) and were found on par with each other and significantly superior over 75% RD N + 25% N through poultry manure (2560 kg ha^{-1}), 75% RD N + 25% N through FYM (2060 kg ha^{-1}) and 75% RD N + *Azotobacter* (1754 kg ha^{-1}). 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 Thuma*et al*. (2016) [9].

Total nitrogen uptake at harvest of pearl millet was maximum with sole crop followed by 100% RDF through neem coated urea, 75% RD N + Pongamia green leaf manure @ 10 t ha^{-1}and 75% RD N + 25% N poultry manure might be due to more dry matter production, grain yields and nutrient content compared to other treatments. Similar results were obtained by Pallavi *et al*. (2015) [5]. Significantly higher phosphorus uptake was observed with sole cropping of pearl millet and it was followed by 100% RDN through neemcoated urea and it was on par with 75% RD N + Pongamia green leaf manure @ 10 t ha^{-1}. The other treatments are significantly differ with each other. Uptake was maximum in sole cropping compared to intercropping in *Melia dubia*. This considerable decline in uptake under intercropping situation might be due to competition for nutrient absorption by trees. These results are in agreement with the findings of Vanlalngurzauva*et al*. (2010) [11]. Similar results were observed with phosphorus uptake.

At harvest, maximum potassium uptake was noticed with sole crop of pearl millet and it was on par with 100% RDN through neemcoated urea under *Melia dubia* followed by 75% RD N + Pongamia green leaf manure @ 10 t ha^{-1}, 100% RDN through normal urea, 75% RD N + 25% N through poultry manure, 75% RD N + 25% N through FYM and 75% RD N + *Azotobacter* The increased uptake in integrated use of manures *viz*., pongamia leaf manure, poultry manure, farmyard manure and *Azotobacter* compared to control is attributed to the fact that they help in reducing the soil pH to some extent by producing organic acids during their decomposition that lead to greater availability and mobility of nutrients mainly of micronutrients. This could have also helped in additional uptake of the nutrients by plants (Togas *et al*., 2017) [10].

Table 1: Yield and nutrient uptake (kg ha^{-1}) of pearl millet as influenced by nutrient management practices under *Melia dubia* based agri-silvi system (Mean of two years)

Treatments	Yield (kg ha^{-1})		Nutrient uptake (kg ha^{-1})		
	Grain	Stover	N	P	K
T1 Control (No fertilizer or manure)	833	1124	31.73	3.86	52.87
T2 100% RDF (80-40-30 kg ha^{-1}) through normal urea	2315	3073	77.74	11.92	146.38
T3 100% RDF (80-40-30 kg ha^{-1}) through neem coated urea	2901	3561	105.21	14.74	194.78
T4 75% RDN + 25%N Poultry manure	1959	2560	66.55	10.12	144.35
T5 75% RDN +25% N FYM	1421	2060	54.81	8.40	111.34
T6 75% RDN + Pongamia green leaf manure 10 t ha^{-1}	2648	3165	91.31	14.39	173.05
T7 75% RDN + Azotobacter 500 g ha^{-1}	1170	1754	48.11	6.72	96.76
T8 Sole crop without trees 80-40-30 kg ha^{-1}	3150	3841	109.52	16.76	200.70
SEm±	109	137	2.59	0.55	5.87
CD (P=0.05)	335	418	5.31	1.13	12.03

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