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Economic evaluation of nutrient management practices in pearl millet under *Meliadubia* based agri-silvisystem

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Abstract
A Field experiment was conducted during *kharif* 2018 to study the economically feasible integrated nutrient management practices in pearl millet under *Melia dubia* based agri-silvisystem. The experiment consisted of eight treatments and laid out in randomised block design with three replications. From the results, it was observed that sole crop of pearl millet recorded significantly higher grain yield, stover yield and resulted in higher net returns and B: C ratio with recommended dose of fertilizers followed by 100% RDF through neem coated urea and 75% RD N + Pongamia green leaf manure 10 t ha^{-1} as intercrop in *Melia dubia*. With respect to whole Agri- silvi system returns, 100% RDF through neem coated urea recorded higher B: C ratio followed by 75% RD N + Pongamia green leaf manure 10 t ha^{-1}.

Keywords: Nutrient management, Pongamia green leaf manure, yield and net returns

Introduction
Pearl millet (*Pennisetum glaucum* L.) known as bajra. It is well adapted to drought, low soil fertile soils (Choudhary*et al*., 2014) [4]. Pearl millet grain is the staple diet and nutritious source of vitamins, minerals and protein, while pearl millet stover is a valuable livestock feed. The productivity of pearl millet is quite low because of growing bajra on marginal, low productive soils with low input management. Continuous use of chemical fertilizer spoils the structure and texture of the soil and also affect environment. Therefore, use of chemical fertilizer alone may not keep pace with time in maintenance of soil health for sustaining the productivity. So, adequate and balanced use of manure and fertilizer is essential for better soil health. 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. Agroforestry is an appropriate and efficient land use system in dry lands, for site improvement and also for optimization of productivity of agricultural crops as well as forest crops. Cultivation of pearl millet as intercrop in the alleys of young plants of *Melia* is desirable to maximize the dry lands and space use efficiency to generate supplemental income during the initial stage of *Meliadubia* in Agri- silviculture system. In this context, the present study is conducted to evaluate economically feasible nutrient management practice in pearl millet.

Materials and Methods
Field experiment was conducted during *kharif* 2018 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 T_1-Control (no fertilizer and manure), T_2-100% RDF through normal urea, T_3-100% RDF through neem coated urea, T_4-75% RD N + 25% N

Poultry manure, T_5-75% RD N + 25% N FYM, T_6-75% RD N + Pongamia green leaf manure @ 10 t ha^{-1}, T_7-75% RD N + *Azotobacter* @ 500 g ha^{-1}, T_8-Sole crop without trees (100% RDF). Pearl millet was intercropped in *Meliadubia* of six years old. The *Meliadubia* trees were 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 phosphate, 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 observation at different stages of crop growth. 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 cost of cultivation for each treatment was worked out. Similarly, gross returns were calculated based on market price of the produce. The net returns were obtained after deducting the cost of cultivation from gross returns. The data on various characters studied during the course of investigation were statistically analysed for randomized block design.

Results and Discussion

Grain yield (kg ha^{-1})

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) [5]. 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 crop and reduced solar radiation on crop canopy. Similar results were reported by Chandana (2018) [2] and Kulkarni *et al.* (2020) [6].

Economics (₹ ha^{-1})

The highest gross returns (₹45,345 ha^{-1}) were recorded with sole crop followed by 100% RDF through neem coated urea (₹.41,805ha^{-1}),75% RD N + pongamia green leaf manure 10 t ha^{-1}(₹38565ha^{-1}), 100% RDF through normal urea (₹ 33240 ha^{-1}),75% RD N + 25% N poultry manure (₹27900 ha^{-1}), 75% RD N + 25% N FYM (₹ 20010 ha^{-1}) and 75% RD N +*Azotobacter* (₹16560 ha^{-1}). Although, cost of cultivation was less in *Azotobacter*, gross returns were less due to reduced grain yields. Similar results were noticed by Kaushik *et al*. (2014) [6].

The highest net returns and B:C ratio (₹31357ha^{-1}and 3.24) were recorded with sole crop followed by 100% RDF through neem coated urea (₹2781 ha^{-1}and 2.99),75% RD N + pongamia green leaf manure 10 t ha^{-1} (₹24384 ha^{-1} and 2.72).100% RDF through normal urea (₹19290 ha^{-1}and 2.32) and the control treatment registered the lowest gross returns (₹11,385 ha^{-1}), net returns (₹2225 ha^{-1}) and B:C ratio (1.24). Use of organic manures increased the cost of cultivation and resulted in lesser benefit-cost ratio compared to 100% RDF treatments. The higher net returns might be due to higher level of biomass accumulation and efficient translocation to the reproductive parts with the supply of adequate nutrients might be responsible for the production of higheryield attributes, which resulted in higher monetary returns and B:C ratio. The lower income obtained in agri-silvi system compared to sole cropping system could be compensated by income from *Melia* trees at maturity in terms of fuel, timber, fodder and other ecological services, besides soil enrichment. Similar results were also reported by Chandana (2020) [3], Swapna *et al*. (2020) [9] and Sahoo *et al*. (2021) [8],

Table 1: Economics of pearl millet as influenced by nutrient management in *Meliadubia* based agri-silvi system

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Cost of Cultivation (₹. ha^{-1})	Gross returns (₹.ha^{-1})	Net returns (₹.ha^{-1})	B:C ratio
T_1 Control (No fertilizer or manure)	759	1694	9160	11385	2225	1.24
T_2 100% RDF (80-40-30 kg ha^{-1}) through normal urea	2216	4545	13950	33240	19290	2.38
T_3 100% RDF (80-40-30 kg ha^{-1}) through neem coated urea	2787	4849	13988	41805	27817	2.99
T_4 75% RDN + 25%N Poultry manure	1860	3733	15156	27900	12744	1.84
T_5 75% RDN +25% N FYM	1334	3302	15781	20010	4229	1.27
T_6 75% RDN + Pongamia green leaf manure @10t ha^{-1}	2571	4173	14181	38565	24384	2.72
T_7 75% RDN + Azotobacter @500gha^{-1}	1104	2886	13106	16560	3454	1.26
T_8 Sole crop without trees 80-40-30 kg ha^{-1})	3023	4916	13988	45345	31357	3.24
SEm±	92	141	-	-	-	-
CD (P=0.05)	278	407	-	-	-	-

Price of pearl millet:₹14.25 kg /grain
Stover yield: 0.75/kg

Table 2: Economics of *Meliadubia* (Tree + crop) based Agri-silvi system

Treatments	COC (₹ha^{-1})	Gross returns (₹ha^{-1})	Net returns (₹ha^{-1})	B:C
T_1 Control (No fertilizer or manure)	64160	273979	209819	6.02
T_2 100% RDF (80-40-30 kg ha^{-1}) through normal urea	68950	256742	187792	6.45
T_3 100% RDF (80-40-30 kg /ha^{-1}) through neem coated urea	68988	325501	256513	8.15
T_4 75% RDN + 25% N through Poultry manure	70156	243009	172853	5.75
T_5 75% RDN + 25% N through FYM	70781	309084	238303	6.52
T_6 75% RDN + Pongamia green leaf manure 10t ha^{-1}	69181	254940	185759	6.65
T_7 75% RDN + Azotobacter 500 g ha^{-1}	68106	281367	213261	6.08
T_8 Sole crop without trees 80-40-30 kg ha^{-1})	13988	45345	31357	-

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Conclusion
From this experiment**,** it can be concluded that bajra as a intercrop in *Melia dubia* responded well to integrated nutrient management *i.e.* application of 75% RDN along with pongmia green leaf manure

Abbreviations
RDN: Recommended dose of nitrogen; RDF: Recommended dose of fertilizers; FYM – Farm Yard Manure; DAS- Days after sowing

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