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# Moth bean [*Vigna aconitifolia* (Jacq.) Marechal] as an Alternative Crop to Groundnut in the Rainfed Areas of Northern Parts of Tamil Nadu, India

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## ABSTRACT

**Background:** Moth bean is an important dry land crop, requires less water and external input for their cultivation. Even though it has great importance, moth bean cultivation is ignored as minimum attention by the farmers. The major reasons for the low productivity of moth bean was the lack of adoption of improved production technologies and non-availability of high yielding variety seeds, timely guidance from village extension workers. Hence, it is imperative to improve the productivity of moth bean through demonstrations under rain-fed conditions.

**Methods:** With the aims to improve the livelihood of farmers and crop diversification, the field demonstrations of the moth bean variety TMV 1 with integrated crop management practices were conducted by ICAR-Krishi Vigyan Kendra, Villupuram. To improve the productivity of moth bean and farmers income through field demonstrations with improved production technologies compared to groundnut cultivation as farmers practice under rainfed condition.

**Result:** Results on package-wise cost ($ha^{-1}$) for three years average incurred for land preparation Rs. 9300, Seed cost Rs. 2400, weed management Rs. 9000, plant protection Rs. 8500 and harvesting cost was Rs.15000. The cost of plant protection and harvesting costs are same for moth bean and groundnut and remaining costs are varied for both crops. The yield was 1595 $kgs.h^{-1}$, gross income Rs. 130000, cost of cultivation Rs. 46,400, net income Rs. 83,700 and benefit-cost ratio Rs. 2.80. The average cost of cultivation for groundnut cultivation (farmers practice) for the three years is Rs. 76,300; gross income Rs. 1,43,000 and net income Rs. 66,700. Hence, moth bean cultivation proved to be better economically than groundnut cultivation in the rainfed ecosystem of Tamil Nadu, contributing to crop diversification and improved livelihood of farming communities.

**Key words:** Cost of cultivation, Gross income, Moth bean, Net income, Seed yield.

## INTRODUCTION

Indian agricultural system mainly depends on rainfed agriculture only. The net cultivated area in India is nearly 140 million ha out of this 50% area under rainfed condition (70 million hectares). It contributes 40% of the total food production and 60% of the total Agricultural GDP. India's population will be expected to reach 1.68 billion by 2030 and the pulses requirement will be 32 million tonnes with the required annual growth rate of 4.2% (Sarkar *et al*., 2018). Globally, India is the largest producer and consumer of pulses accounting for about 25% of production, 27% of consumptionand 34% of food use (Pooniya *et al*., 2015). Pulses are an important group of food crops considered a protein source for both human as well as animal nutrition and they play an important role in national food and nutritional security (Bhat and Karim, 2009). Moth bean is rich in protein (22-24%), vitamins, carbohydrates and minerals. It is an excellent source of digestible protein with low flatulence and is consumed as dal, sprouts, noodles, green beans and boiled dry beans as well. It is being cultivated for food as well as dry plants make good fodder. The green fodder of moth bean is also superior to cowpea in case of digestibility (Das and Arora 1997; Sanadya *et al*., 2021).

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Moth bean is largely cultivated in rainfed conditions and farmers' are gets low yield, mainly due to not adopting new production techniques resulting in low productivity in India. Timely sowing, maintain optimum plant populations and suitable agronomic practices are the main key factors to determine the crop growth and higher yield of the rainfed crop. Moth bean is grown throughout the tropical, sub-tropical and warmer regions of the world between 30°N and 35°S latitude. It tolerates heat and drought. It prefers a moist climate during the vegetative period and the cool and dry period during the reproductive stage. It was a dew loving plant. The cloudy weather and optimum rainfall during vegetative period are ideal for this crop. Rainfall is the prime source of water resources for moth bean cultivation in rainfed farming. Sowing immediately after the receipt of rainfall leads to difficulties in sowing operation and reduces the availability of soil moisture during the crop growth period. To avoid these difficulties, the pre-monsoon sowing method has been adopted for rain-fed farming to enhance the crop growth and yield (Ammaiyappan *et al*., 2019).

Farmers are cultivating moth bean under rainfed conditions in Tamil Nadu especially during *Rabi* season immediately after receiving rainfall without any preparatory work especially fine tillage and addition of manures. The front line demonstration (FLD) is an important method in any crop for transferring the latest package of practices (technologies) in to farmers (Bezbaruah and Deka, 2020). Pulses cultivating farmers getting, low yield and income mainly due to improper management practices, delayed sowing and indiscriminate use of pesticides. To address these problems in northern districts of Tamil Nadu, the present study was undertaken to assess the cost and economics difference between demonstrated technologies of moth bean and groundnut cultivation followed by the local farmers as farmers practices.

## MATERIALS AND METHODS

### Description of study area

Field demonstrations on integrated crop management (ICM) on moth bean were conducted under rainfed conditions by Krishi Vigyan Kendra, Villupuram, Tamil Nadu during *Rabi* 2021-22 to 2023-24 (three years). The study area was consist of Mailam and Vikravandi blocks of Villupuram district (latitude; 11°46′North; longitude: 79°.46′ East; altitude: 4.60 m MSL). For this intervention a total of 75 demonstrations (25 demonstrations/ year) were conducted under rainfed ecosystem. The climatic conditions of the research locations are tropical. The soil type of the demonstrated area is well-trained sandy loam soils with pH 7.0- 7.5. Average rainfall of the region is 850-950 mm per annum and relative humidity ranges from 45-85 per cent.

### Research methodology and monitoring

Moth bean cultivation is highly suitable for rainfed light soils where the average annual rainfall is 850 mm. For this intervention, moth bean seeds are distributed to the selected farmers on no cost basis to conduct the demonstrations. Moth bean crop was sown by line sowing method with the recommended seed rate (20.0 kg.ha$^{-1}$). The line sowing by 30 cm × 10 cm spacing was followed in all the demonstrations for moth bean with optimum soil moisture. Seed treatment was performed before sowing by Carbendazim 50% WP @ 2.0 g. kg$^{-1}$ of seeds. Sowing was completed every year on 15$^{th}$ November to 15$^{th}$ December (pre-monsoon period) with optimum soil moisture conditions in all the three years. For weed management, the pre-emergence herbicide application was done as per the recommended practice (Pendimethalin 38.7% CS @ 1.75 lit. ha$^{-1}$ in 200 litres of water). During 25-30$^{th}$ days after sowing, one hand weeding was recommended and carried out by the farmers in all the demonstrations. Foliar nutrients of TNAU Pulse wonder was applied as per the recommended dose (2.0 kgs/ac.) during pre-flowering stage (at 40-45 DAS). Need-based application of insecticides and fungicides were done as per the recommendations. Harvested the crop manually at 75-80 days, when the pods are turns brown. All the moth bean demonstrations were monitored by KVK Scientists periodically and recommended the improved production technologies. The harvested produce was dried (8-10% seed moisture level) and sold in a district regulated market. From the quantity of sold products (yield) and selling price the gross income and net income was worked out. The B:C ratio was worked out as follows:

$$\text{Benefit: Cost} = \frac{\text{Gross income (Rs)}}{\text{Cost of cultivation (Rs)}}$$

Groundnut crop was also grown as per the farmer's knowledge, in addition to the moth bean crop and it was taken into consideration as farmer's practice. All the field operations (practices) cost for the moth bean and groundnut were recorded periodically and worked out cost of cultivation. The economic parameters (Gross income, net income and B: C ratio) were worked out on the basis of prevailing market prices of inputs and minimum support prices of outputs for the both two crops and compared. Based on the yield, the gross income and net income were determined and critically analyzed and compared on the cost of production wise.

## RESULTS AND DISCUSSION

Moth beans can be grown in a wide range of soil types from sandy loam to clay loam soils. The crop performs well on well-drained sandy loamy soils. The cost of all the field operations (practices) for moth bean demonstrations and production cost (cost of cultivation) of groundnut crop in rainfed ecosystem are presented in Table 1. *Rabi* sowing was best season for Tamil Nadu under rainfed condition (November-December sowing) and early sowing was always better. Sowing was planned in such a way that flowering and pod formation should be coinciding with after

rainy period. Tuteja, (2000) reported that lower adoption of improved production technologies, non-availability high yielding variety seeds in time and good quality bio fertilizers are the major constraints in the production of pulses. Verma *et al.* (2024) the cost of cultivation of crops can vary widely depending on factors such as the type of crop and region and it was essential to calculate these costs accurately to ensure profitability for farmers.

Land preparation for moth bean requires only minimum (1-2) ploughing operations but groundnut crops requires finer operations (2-3 ploughing) to form the soil in fine tilth form to get a good germination. The three years average cost towards the land preparation for moth bean was Rs. 9200/- ha$^{-1}$ and the groundnut crop costs were Rs. 9900/- ha$^{-1}$ (three years average cost). The seed rate for moth bean was lower 20 kg.ha$^{-1}$ and groundnut had higher seed rate of 100 kg.ha$^{-1}$. Thus, moth bean has a lower seed cost of Rs. 2400/- ha$^{-1}$ compared to the seed costand groundnut has higher cost of Rs. 13,600 ha$^{-1}$ with recommended spacing.

Fertilizer cost also differentiating each other, for moth bean no fertilizer cost, foliar nutrients only applied and cost was Rs. 1500/- ha$^{-1}$only (no basal application and top dressing) but fertilizer cost for groundnut was Rs. 8500/- ha$^{-1}$ for average of the three years (as per the farmers practice). Moth bean crop needs no inter cultivation practices, whereas in groundnut Rs. 5000/- ha$^{-1}$ because groundnut needs one extra inter-cultural operation (earthing up) and fertilizers application. The herbicide cost of moth bean are includes pre-emergence application of Pendimethalin 38.7%CS @ 2.5 lit.ha$^{-1}$ and one hand weeding was Rs. 9300/ha$^{-1}$, for Groundnut the cost of pre and post-emergence herbicides as well as one hand weeding was Rs. 15,200/ha$^{-1}$, since, the groundnut crop may require second hand weeding. Plant protection measures cost throughout the season against major pests (aphids, spodoptera, pod borers) and important diseases and other need-based protection measures costs for both crops (Moth bean and groundnut) incurred Rs. 9000/- ha$^{-1}$. The harvesting cost for the three year average incurred for moth bean was Rs. 15000/- ha$^{-1}$ and to groundnut Rs. 15000/- ha$^{-1}$. Getting higher yield and labour shortage were major problem in both crops. When we examined the yields of both crops, the average yield of moth bean was 1595 kg.ha$^{-1}$ and groundnut was 2200 kg.ha$^{-1}$ were recorded (average of three years). These outcomes were in line with the reports of Raj Singh (2008) and Sabhita *et al*. (2017) in moth bean. Similar kind of results on rice was reported by Ganapathy *et al*. (2024). Productivity enhancement and gap analysis in moth bean through improved production technologies at farmer's participatory mode has demonstrated by Meena and Singh (2016).

Comparison of all the three years data on yield, cost of cultivation, gross income and net income are presented in Table 2. The harvested products were dried and sold at regulated market @ Rs. 85/ kg$^{-1}$ for moth bean and Rs. 65/- kg$^{-1}$ for groundnut (average of three years). The results revealed that, when compared to the all aspects of gross income, cost of cultivation, net income of moth bean and groundnut, moth bean crop has lower cost of cultivation and higher net income over the groundnut crop under rainfed condition of Tamil Nadu (Table 2). The cost of cultivation of moth bean crop is the total costs incurred on various inputs that are used in different operations was Rs. 46,400/ha$^{-1}$; gross income was Rs. 1,30,100/ ha$^{-1}$ and net income was Rs. 83,700/ha$^{-1}$. Similarly, for groundnut crop also the gross income (Rs.143,000); cost of cultivation (Rs.76,300) and net income (Rs. 66,700) was worked out. Sadashivana Gowda *et al.* (2017) reported that moth bean crop recorded higher seed yield (983 ha$^{-1}$) and net returns of (Rs. 42,425 ha$^{-1}$) in their study by adopting proper agronomic practices. The front line demonstration and economic analysis on moth bean was already reported by Sabhita *et al.,* (2017); Harish Kumar Rachhoya, (2020) and Choudhary *et al.* (2021) in moth bean. The profitability of an enterprise depends upon income-generating capacity and cost structure (Renuka *et al*., 2019). Benefit-cost ratio was indicating that with the cultivation of moth bean has more B: C ratio of Rs. 2.80 compared to the groundnut was

**Table 1:** Cost of cultivation of moth bean and groundnut cultivation under rainfed condition for three years (2021-22 to 2023-24).

| Field operations/ Practice | Moth bean (Demonstration) | | | | Groundnut (as farmers practice) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2023 | Average | 2021 | 2022 | 2023 | Average |
| Land preparation (Rs) | 9000 | 9000 | 9600 | 9200 | 9600 | 9600 | 10500 | 9900 |
| Seed rate (kg ha$^{-1}$) | 20 | 20 | 20 | 20 | 100 | 100 | 100 | 100 |
| Seed cost (Rs.) | 2400 | 2400 | 2400 | 2400 | 13500 | 13300 | 14000 | 13600 |
| Fertilizers cost (Rs.) | 1500 | 1500 | 1500 | 1500 | 8500 | 8500 | 8500 | 8500 |
| Inter cultivation | 0 | 0 | 0 | 0 | 4500 | 5000 | 5500 | 5000 |
| Weed management | 9000 | 9000 | 9900 | 9300 | 15000 | 15000 | 15600 | 15200 |
| Plant protection cost | 8500 | 9000 | 9500 | 9000 | 8500 | 9000 | 9500 | 9000 |
| Harvesting cost (Rs.) | 15000 | 15000 | 15000 | 15000 | 15000 | 15000 | 15000 | 15000 |
| Total cost (Rs.) | 45400 | 45900 | 47900 | 46400 | 74700 | 75500 | 78700 | 76300 |
| Yield (Kg)/ha$^{-1}$ | 1500 | 1660 | 1625 | 1595 | 2150 | 2250 | 2200 | 2200 |

**Table 2:** Yield and economic of moth bean and groundnut cultivation under rainfed condition for three years.

| Crop/Year | Yield (kg/ha) | Gross income (Rs.) | Cost of cultivation (Rs.) | Net income (Rs.) | B: C ratio |
|---|---|---|---|---|---|
| **Moth bean** | | | | | |
| 2021-22 | 1500 | 127500 | 45400 | 82100 | 2.81 |
| 2022-23 | 1660 | 132800 | 45900 | 86900 | 2.89 |
| 2023-24 | 1625 | 130000 | 47900 | 82100 | 2.71 |
| Average | 1595 | 130100 | 46400 | 83700 | 2.80 |
| **Groundnut** | | | | | |
| 2021-22 | 2150 | 139750 | 74700 | 65050 | 1.87 |
| 2022-23 | 2250 | 146250 | 75500 | 70750 | 1.94 |
| 2023-24 | 2200 | 143300 | 78700 | 64300 | 1.82 |
| Average | 2200 | 143000 | 76300 | 66700 | 1.87 |

Rs. 1.87. The frontline demonstrations on moth bean have reported earlier by Shayam Das *et al.* (2018); Ruheentaj *et al*. (2020) and Priyaranjan Swain *et al*. (2023). The similar results of frontline demonstrations on chick pea (*Cicer aritinum*) have been reported by Kumar *et al.* (2018); Kantwa *et al*. (2024) and Hashim *et al*. (2024) in their research papers in Legume Research. The CFLD pulses on blackgram productivity and profitability has been reported by Abraham *et al.* (2024). The analysis of economic parameters has already reported in chickpea by Jakhar *et al.* (2024), indicated that the cost of indulging in the adoption of latest technology in chickpea varied and was more profitable. Upesh Kumar *et al*. (2023) have reported that Cluster Frontline Demonstration was an effective technology dissemination approach for enhancing the productivity and profitability in black gram (*Vigna mungo*). Gap analysis and economics of front line demonstrations in moth bean under rainfed condition has already been reported by Shivran *et al.* (2020) which was witness to our results.

## CONCLUSION

Cultivation of moth bean crop has proved better economically, when we compared with groundnut cultivation under rainfed ecosystem in terms of production costs (cost of cultivation). Moth bean has added advantages over groundnutand other crops in rainfed conditions. The advantages are, short duration (75-75 days), drought tolerant and less care crop (low cost of cultivation) and suitable for *Rabi* season (dew lowing crop). From the results of the present study concluded that, the B: C ratio and net returns are higher for moth bean cultivation when compared to groundnut cultivation, hence moth bean crop under rainfed cultivation as an alternative crop to groundnut for rainfed conditions in Tamil Nadu and moth bean crop with integrated crop management practices will uplift the economy of the farming community.

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### Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions.

### Conflict of interest

All authors declare that they have no conflicts of interest.

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