Archives of Current Research International

Volume 25, Issue 2, Page 69-75, 2025; Article no.ACRI.130457
ISSN: 2454-7077

Effect of Intercropping on Growth and Yield of (*Hibiscus sabdariffa* L.), Mesta (Roselle) in India

Y. Sandhya Rani [a++*], T. Sreelatha [b#], M. Srinivasa Rao [c†], B. Swathi [a‡], G. Chitti Babu [a^] and S. Mitra [d##]

[a] *Agricultural Research Station, Amadalavalasa, ANGRAU, Srikakulam-532185, Andhra Pradesh, India.*
[b] *RARS, Anakapalle-531001 Andhra Pradesh, India.*
[c] *Agricultural Research Station, Ragolu, ANGRAU, Srikakulam-532185, Andhra Pradesh, India.*
[d] *AINP on J&AFICAR-CRIJAF, Barrackpore- 700121, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/acri/2025/v25i21068

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/130457

Original Research Article

Received: 30/11/2024
Accepted: 01/02/2025
Published: 07/02/2025

ABSTRACT

Mesta, scientifically called as *Hibiscus sabdariffa* (Roselle) is an herbaceous annual plant and lignocellulosic fibre crop is more adaptive under diverse conditions of climate, soil and also resistant to drought. The area under mesta crop is gradually decreasing from the past ten years

[++] *Scientist (Soil Science and Agricultural Chemistry);*
[#] *Principal Scientist (Soil science and Agricultural Chemistry);*
[†] *Scientist(Agronomy);*
[‡] *Scientist (Plant Pathology);*
^ *Scientist (Entomology);*
[##] *Principal Scientist and In-Charge;*
**Corresponding author: Email: sandhyarani33756@gmail.com;*

Cite as: *Rani, Y. Sandhya, T. Sreelatha, M. Srinivasa Rao, B. Swathi, G. Chitti Babu, and S. Mitra. 2025. "Effect of Intercropping on Growth and Yield of (Hibiscus Sabdariffa L.), Mesta (Roselle) in India". Archives of Current Research International 25 (2):69-75. https://doi.org/10.9734/acri/2025/v25i21068.*

due to fluctuating price structure, erratic rainfall and introducing crops like maize. Intercropping is one of the most feasible practices under crop diversification and has been a prominent feature for crop production in small holdings in developing countries. Intercropping is promoted among the farmers not only for enhancing farm productivity per unit land but also ensure security against potential risk of monoculture. This can indeed stabilize the diversified needs of the farming households whose production is greatly influenced by vagaries of nature. Considering the importance and possibilities to save the scarce inputs like nutrients, water etc. without reducing the yield and better utilization of land, an investigation was done for three years consecutively at Agricultural Research Station, Amadalavalasa from 2021-2023 during the *kharif* season to study the feasibility of growing suitable intercrops with mesta on sandy loam soils. The experiment was laid in Randomized Block Design with nine treatments to study the sustainability and profitability of mesta based intercropping system. The data revealed that the mesta + groundnut (3:4) intercropping (33.14 q/ha) recorded the highest mesta fibre equivalent yield followed by mesta + blackgram (3:4). Among the treatments, highest gross returns (Rs. 71134 Rs/ha) was recorded with mesta + groundnut (3:4) treatment with a B:C ratio of 2.59, while the lowest was recorded with mesta + rice (3:4) intercropping system. Hence, keeping in view of the yield and B:C ratio, intercropping system of mesta + groundnut (3:4) followed by mesta + blackgram (3:4) can be suggested as the best alternative cropping pattern to the farmers instead of cultivating a sole mesta crop.

Keywords: Mesta; sandy loam soils; intercropping; groundnut; fibre yield; benefit cost ratio.

1. INTRODUCTION

Roselle (*Hibiscus sabdariffa* L.), also known as mesta, belongs to the Malvaceae family and is believed to have originated from West Africa. It is a hardy, drought-resistant crop which is widely cultivated in tropical and sub-tropical regions. In particular, mesta is grown for its fibre, which is used in many industrial applications (Ananthi et al., 2019). The plant is valued for its calyx, which is rich in water, fibre, protein and citric acid. The fibre content and other chemical properties make it a commercial crop next to jute and cotton (Kumar et al., 2020).

In India, mesta is predominantly grown in regions like Andhra Pradesh, Odisha, West Bengal and others, particularly during the *kharif* season. In Andhra Pradesh, districts like Vizianagaram and Srikakulam contribute significantly to mesta production. Despite its earlier prominence, the cultivation of mesta in Andhra Pradesh has declined significantly, from 240,000 hectares in the 1950s to just around 868 hectares today (http://agricoop.nic.in). This decline is largely due to the expansion of irrigation projects in the state, leading farmers to shift towards crops like paddy, maize and cotton. Mesta has faced stiff competition from other high-yielding and high-value crops, which provide better economic returns in terms of both yield and market price (Islam et al., 2021; Shivakumar et al., 2022). With the promise of higher profits, many farmers have shifted away from mesta cultivation. Moreover, another primary challenge faced by mesta cultivation is the low nitrogen content in the soil. To improve yields, nitrogen fertilization is essential but can be costly. A more cost-effective method to enhance soil fertility is through intercropping with legumes, which can fix nitrogen biologically and improve soil health (Giller et al., 2016).

1.1 Intercropping in Mesta Cultivation

Intercropping, the practice of growing two or more crops simultaneously in the same field can have numerous benefits. These include improved soil fertility, better resource utilization, risk reduction and increased yields (Dhar et al., 2015; Mukul & Akter, 2021). This system also provides added benefits such as reduced pests and diseases pressure, enhanced weed control and better moisture retention. The use of legumes in intercropping systems is beneficial for nitrogen fixation, which enhances the soil's fertility for subsequent crops (Raza et al., 2022). The combination of crops with different growth patterns can maximize the use of available resources like sunlight, water, and nutrients. Moreover, intercropping can lead to higher total yield compared to mono-cropping. While the yield of each individual crop may be lower when intercropped, the overall yield from the mixed crops is often higher (Yin et al., 2020). This is due to the complementary growth patterns and resources that different crops utilize. Intercropping reduces the risk of complete crop failure due to varying growth speeds and environmental needs (Mitra et al., 2006).

This study investigated the effect of intercropping Roselle (mesta) with crops like black gram, greengram, groundnut and rice with the following objectives:-- (1) To assess the effect of intercropping Roselle (mesta) with various crops on its growth and yield, (2) evaluate the productivity, profitability and sustainability of mesta-based intercropping systems and (3) examine the impact of leguminous crops in intercropping on nitrogen content in the soil.

2. MATERIALS AND METHODS

The experiment was laid out in randomized block design with 9 treatments and 3 replications at Agricultural Research Station, Amadalavalasa, Srikakulam district, A.P. These treatments were: T1: Sole Mesta, T2: Sole Rice, T3: Sole Groundnut, T4: Sole Greengram, T5: Sole Blackgram, T6: Mesta + Rice (3:4), T7: Mesta + Groundnut (3:4), T8: Mesta + Greengram (3:4), T9: Mesta+ Blackgram (3:4). The experiment was conducted consequently for 3 years during 2021-2023 during *kharif* season in a plot size of 7.2 x 5.4 m. The soil was moderately acidic in reaction (pH-5.83), medium in organic carbon (0.51%), low in available N (206 kg/ha) and medium in available P_2O_5 (24 kg/ha) and K_2O (288 kg/ha). Nitrogen, P_2O_5 and K_2O were applied as basal dressing @ 60:30:30 kg/ha for mesta and 20:40:40 kg/ha for groundnut, greengram and blackgram intercrops. The seed rate used for component crop in intercropping situations was based on their ratios of land use. The crop was sown in the first fortnight of June in all the three seasons. All agricultural practices were done in main and intercrops as required and the crops were harvested at physiological maturity. Growth attributes were recorded during crop growth stages while yield attributes were recorded after harvesting of crop. The MEY (mesta equivalent yield) and Benefit Cost Ratio of each treatment was calculated on nearest market price of produce. Both initial and final soil samples were collected and analysed for physico-chemical properties and available soil macronutrients determined as per the standard procedures.

3. RESULTS AND DISCUSSION

Growth Parameters: The maximum basal diameter of mesta stem was recorded from Mesta + groundnut (3:4) intercropping (20.6 mm), very closely followed by sole mesta (19.0 mm) and the lowest was observed with the treatment T6. Similarly, the plant height was highest in the treatment mesta + groundnut (3:4) intercropping (365.0 cm) and it was significantly higher than all other treatments, followed by sole mesta crop (358.2 cm). The height of mesta plant was significantly lowest when it was intercropped with rice in 3:4 ratio (331.2 cm). Highest green biomass was observed with the sole mesta treatment (280.3 q/ha) and the lowest was again observed when mesta was intercropped with rice in 3:4 ratio (209.1 q/ha). These findings are consistent with the observations of similar studies, which have shown that intercropping with legumes such as groundnut often enhances growth and biomass production due to complementary resource use (Suresh et al., 2018; Kumar & Singh, 2020), while the introduction of cereals like rice may reduce biomass accumulation in mesta due to competition for resources (Reddy et al., 2019).

Mesta Fibre yield (Table 2): The sole crop of Mesta (T1) significantly produced the highest fibre yield (21.59 q/ha) compared to other intercropping treatments, primarily due to the higher plant population density in the sole crop, which contributed to greater fibre production. Among the intercropping systems, the highest fibre yield (16.86 q/ha) was observed in Mesta + groundnut (3:4) intercropping. These results align with findings by Singh et al. (2012) and Mandal and Majumdar (2010), who also reported higher fibre yields in intercropping with legumes like groundnut. The lowest fibre yield (9.84 q/ha) was observed when Mesta was intercropped with rice in a 3:4 ratio, likely due to the competition for resources between the crops.

In terms of pod yield, the sole crop of groundnut produced the highest pod yield (32.33 q/ha), significantly higher than its intercropping with Mesta (8.94 q/ha), reflecting the negative impact of competition between the crops. The highest System Mesta Equivalent Yield (SMEY) (33.14 q/ha) was recorded in the Mesta + groundnut (3:4) intercropping system, indicating its overall superior productivity. In contrast, the lowest SMEY was recorded in the sole rice treatment (10.56 q/ha), followed closely by the Mesta + rice (3:4) intercropping treatment (13.78 q/ha). These findings emphasize the importance of selecting appropriate companion crops for intercropping systems to maximize yields and system productivity, as highlighted by similar research (Kumar et al., 2015; Patel et al., 2017).

Table 1. Effect of inter cropping on growth parameters of mesta crop

Treatments	Plant height (cm)	Basal diameter (mm)	Green biomass (q/ha)
T_1: Sole mesta	358.2	19.0	280.3
T_2: Sole rice	-	-	-
T_3: Sole ground nut	-	-	-
T_4: Sole green gram	-	-	-
T_5: Sole black gram	-	-	-
T_6: Mesta + rice (3:4)	331.2	16.9	212.2
T_7: Mesta + groundnut (3:4)	365.0	20.6	254.9
T_8: Mesta + green gram (3:4)	349.5	17.9	209.1
T_9: Mesta + black gram (3:4)	354.5	18.4	219.8

Table 2. Effect of inter cropping on yield of mesta fibre (q/ha) and Intercrops(q/ha)

Treatments	Mesta Fibre yield (q/ha)	Sole crop yield (q/ha)	Intercrop yield (q/ha)	System MEY (q/ha)
T_1: Sole mesta	21.59	-	-	21.59
T_2: Sole rice	-	16.93	-	10.56
T_3: Sole ground nut	-	17.74	-	32.33
T_4: Sole greengram	-	7.72	-	18.88
T_5: Sole blackgram	-	7.28	-	17.80
T_6: Mesta + rice (3:4)	9.84	-	6.32	13.78
T_7: Mesta + groundnut (3:4)	16.86	-	8.94	33.14
T_8: Mesta + greengram (3:4)	12.59	-	2.40	18.45
T_9: Mesta + blackgram (3:4)	16.47	-	2.14	21.71
Mean				**20.92**
SEm±				**0.95**
CD (5%)				**2.75**
CV %				**7.83**

Table 3. MEY and BCR of mesta based Intercropping systems (Rs/ha)

Treatments	System MEY (q/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net Returns (Rs/ha)	B:C
T_1: Sole mesta	21.59	45400	75578	30178	1.66
T_2: Sole rice	10.56	54250	36964	-17286	0.68
T_3: Sole ground nut	32.33	45376	113147	67771	2.49
T_4: Sole greengram	18.88	19783	66067	46284	3.34
T_5: Sole blackgram	17.80	20383	50597	30214	2.48
T_6: Mesta + rice (3:4)	13.78	50440	48244	-2196	0.96
T_7: Mesta + groundnut (3:4)	33.14	44868	116002	71134	2.59
T_8: Mesta + greengram (3:4)	18.45	32072	64578	32506	2.01
T_9: Mesta + blackgram (3:4)	21.71	32372	72526	40154	2.24

Benefit Cost Ratio (Table 3): The highest net income of Rs. 711,134 per hectare was observed under the Mesta + groundnut (3:4) intercropping system, with a Benefit-Cost (B:C) ratio of 2.59. This high profitability can be attributed to the superior performance of both crops in this intercropping system, leading to increased overall production and efficient resource utilization. Conversely, the lowest net income of Rs. 2,196 per hectare was recorded in the Mesta + rice (3:4) intercropping treatment, with a B:C ratio of 0.96. This low profitability is primarily due to the poor performance of rice as an intercrop, which likely suffered from competition for resources with Mesta, thereby reducing overall yields. These findings are consistent with similar

Table 4. Post-harvest soil fertility status as influenced by mesta based intercropping

Sl No	Treatments	pH	EC (dS/m)	OC (%)	Av. N (kg/ha)	Av. P_2O_5 (kg/ha)	Av. K_2O (kg/ha)
T1	Sole Mesta(30 cm×10 cm)	6.12	0.09	0.52	220	26	295
T2	Sole Rice (20 x 10 cm)	6.04	0.10	0.50	211	28	287
T3	Sole Groundnut (30 cm×10 cm)	6.15	0.06	0.49	233	31	297
T4	Sole Greengram (30 cm×10 cm)	6.06	0.07	0.54	237	30	292
T5	Sole Blackgram (30 cm×10 cm)	6.01	0.06	0.51	237	29	300
T6	Mesta+ Rice (3:4)	6.09	0.10	0.49	222	31	292
T7	Mesta+ Groundnut (3:4)	6.05	0.08	0.54	228	31	305
T8	Mesta+ Greengram(3:4)	6.08	0.09	0.51	231	27	302
T9	Mesta + Blackgram(3:4)	6.06	0.08	0.52	235	31	291
Initial		5.83	0.02	0.51	206	24	288
S.Em ±		0.18	0.08	0.02	11.14	1.04	17.06
CD (5%)		NS	NS	NS	NS	3.02	NS
CV %		6.11	13.46	8.85	8.52	8.20	10.07

studies where intercropping systems that combine legumes and other crops often show higher profitability compared to systems with less compatible crop combinations (Yadav et al., 2014; Patel & Reddy, 2016). Moreover, the profitability of intercropping systems depends heavily on the crop interactions and their ability to complement each other in terms of growth and resource use.

Soil properties (Table 4): The physicochemical properties of the soil (pH and E.C), soil organic carbon, available N and K_2O showed no significant influence with the intercropping of mesta with different crops, whereas, the soil available phosphorus showed significant difference between the treatments. These results were in close agreement with Rurinda et al. (2014).

4. CONCLUSION

The results of this study revealed that mesta + groundnut (3:4) recorded the highest mesta equivalent yield compared to sole mesta with maximum net returns of 71134 Rs/ha and 31.4% higher yield over the sole mesta crop a crop (30178 Rs/ha). Intercropping mesta with groundnut being an leguminous crop improved the overall growth of both crops due to complementarity effect compared to their monocropped counterparts. The plants in the intercrop system had better canopy cover, which can be attributed to the complementary growth habits of the crops.

Hence, mesta + groundnut (3:4) intercropping should be recommended as a viable cropping system for maximizing both yield and net returns. The complementarity between the crops leads to improved overall growth, better canopy cover, and increased resource utilization efficiency, which enhances productivity. Future research should focus on long-term sustainability studies to understand how mesta + groundnut intercropping affects soil fertility, pest dynamics, and crop disease resistance over multiple growing seasons. This will help in developing best practices for maintaining productivity without depleting soil health.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Ananthi, T., Amanullah, M. M., & Vennila, C. (2019). Economics of different intercropping systems of maize under mycorrhizal inoculation and different fertilizer levels. *Current Journal of Applied Science and Technology, 37*(2), 1–10.

Dhar, P., Kar, C. S., Ojha, D., Pandey, S. K., & Mitra, J. (2015). Chemistry, phytotechnology, pharmacology and nutraceutical functions of kenaf (Hibiscus cannabinus L.) and roselle (Hibiscus sabdariffa L.) seed oil: An overview. *Industrial Crops and Products, 77*, 323-332.

Giller, K. E., Beare, M. H., Lavelle, P., & Mateen, S. (2016). Agroecological approaches to managing soil fertility and nutrient cycling in tropical farming systems. *Field Crops Research, 189*, 105-119.https://doi.org/10.1016/j.fcr.2016.02.004

Islam, A. A., Osman, M. B., Mohamad, M. B., & Islam, A. M. (2021). Vegetable Mesta (Hibiscus sabdariffa L. var sabdariffa): A potential industrial crop for Southeast Asia. In *Roselle* (pp. 25-42). Academic Press.

Kumar, S., Dhankhar, S. K., Chauhan, A., Kumar, R., & Kumar, S. (2020). Computation of economic feasibility of brinjal and palak intercropping system. *Current Journal of Applied Science and Technology, 39*(6), 74–79.

Kumar, S., Singh, N., & Gupta, R. (2015). Productivity and economic feasibility of intercropping systems in cotton-based cropping systems. *Agricultural Systems, 56*(4), 80-89.

Kumar, R., & Singh, P. (2020). Impact of intercropping systems on the growth dynamics of crops and soil health. *Agricultural Systems, 47*(2), 182-190.

Mandal, B. K., & Majumdar, A. (2010). Studies on intercropping systems with jute in rainfed upland. In P. Palit, M. K. Sinha, S. Meshram, S. Mitra, S. K. Laha, A. R. Saha,

& B. S. Mahapatra (Eds.), *Jute and allied fibres production, utilization and marketing* (pp. 235-243). Indian Fibre Society Eastern Region.

Mitra, S., Maiti, S. N., & Sarkar, S. (2006). Recommendations for jute and allied fibre crops: An endeavour of All India Network Project. *CRIJAF*, Barrackpore, Kolkata.

Mukul, M. M., & Akter, N. (2021). Morpho-anatomical variability, principal component analysis and Euclidean clustering of tossa jute (Corchorus olitorius L.). *Heliyon, 7*(5).

Patel, H., Reddy, G., & Rao, S. (2017). System productivity and economics of intercropping in tropical agroecosystems. *Agricultural Science Digest, 37*(2), 91 -98.

Patel, R., & Reddy, K. (2016). Evaluation of intercropping systems for sustainable production and profitability in cotton-based cropping systems. *Agricultural Economics Research Review, 29*(1), 11-19.

Raza, A., Ahmed, M., Naeem, M., & Hammad, H. M. (2022). Role of legumes in improving soil fertility and nutrient cycling in intercropping systems. *Sustainability, 14*(18), 11574. https://doi.org/10.3390/su141811574

Reddy, Y., Manohar, R., & Varma, K. (2019). Influence of intercropping systems on biomass production and growth of mesta in tropical agro-ecosystems. *Field Crops Research*, 123(3), 65-72.

Rurinda, J., Mapfumo, P., Van Wijk, M. T., Mtambanengwe, F., Rufino, M. C., & Chikowo, R. (2014). Comparative assessment of maize, finger millet and sorghum for household food security in the face of increasing climatic risk. *European Journal of Agronomy, 55*, 29-41.

Shivakumar, R., Vidya Sagar, G. E. C., Suresh, K., Kumar Sharma, S. H., & Naik, D. S. (2022). Effect of sequential intercropping systems and integrated nutrient management on nutrient uptake of pigeonpea. *International Journal of Environment and Climate Change, 12*(6), 65–74.

Singh, M. V., Neeraj, K., & Singh, R. K. (2012). Production potential of mesta intercropped with pigeonpea. *Annuals of Plant and Soil Research, 14*(1), 50-51.

Suresh, P., Singh, V., & Patel, M. (2018). Effects of intercropping on the growth and yield of mesta (Hibiscus cannabinus L.) and associated crops. *Journal of Agronomy, 42*(4), 455-461.

Yadav, M., Sharma, S., & Kumar, V. (2014). Economic performance of intercropping systems in maize-based cropping systems in semi-arid regions. *Indian Journal of Agricultural Economics, 69*(2), 214-221.

Yin, W., Chai, Q., Zhao, C., Yu, A., Fan, Z., Hu, F., & Coulter, J. A. (2020). Water utilization in intercropping: A review. *Agricultural Water Management, 241*, 106335.

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/130457