Effect of Intercropping on Growth and Yield of Mesta (Roselle)

Abstract:

Mesta, 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 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 alongside creating a platform for stabilizing the diversified needs of the farming households whose production is greatly influenced by vagaries of nature. Considering the importance and possibilities to save the precarious inputs like nutrients, water etc. without harming the yield and better utilization of land an investigation was under taken consecutively for three years at Agricultural Research Station, Amadalavalasafrom 2021-2023 during the *kharif* season to study the feasibility of growing suitable intercrops with mesta on sandy loam soil. Among the nine treatments studied, the data revealed that the sole groundnut treatment recorded maximum Mesta fibre equivalent yield (33.47 q/ha) which was statistically at par with mesta + groundnut (3:4) intercropping (29.66 q/ha). Among the treatments, highest gross returns (Rs. 114232/ha) was recorded with mesta + groundnut (3:4) treatment while sole greengram treatment recorded highest B: C ratio (2.93) followed by mesta + blackgram (3:4) (2.60) and mesta + ground nut (3:4) (2.55) intercropping systems.

Key words: Mesta, Sandy loam soils, Intercropping, Groundnut, Fibre yield, Economics

Introduction:

Roselle (*Hibiscus sabdariffa* L.), also known as mesta, belongs to the Malvaceae family and is believed to have originated in West Africa. It is a hardy, drought-resistant crop and is widely cultivated in tropical and sub-tropical regions. In particular, mesta is grown for its fiber, which is used in a variety of industrial applications (Ananthi et al., 2019). The plant is valued for its calyx, which is rich in water, fiber, protein and citric acid. The fiber 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. 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.

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 pest and disease pressure, enhanced weed control, and better moisture retention. The use of legumes in intercropping systems is particularly beneficial for nitrogen fixation, which enhances the soil's fertility for subsequent crops.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).

The present experiment was aimed to study the effects of intercropping Roselle (mesta) with crops like blackgram, greengram, groundnut, rice, and maize with the following objectives- To assess the effects of intercropping Roselle (mesta) with various crops on its growth and yield, evaluate the productivity, profitability and sustainability of Mesta-based intercropping systems and examine the impact of leguminous crops in intercropping on soil fertility, particularly nitrogen content.

Materials and Methods:

The experiment was laid out to study the effect of mesta based intercropping system towards yield of sole and intercrop in randomized block design with 9 treatments and 3 replications at Agricultural Research Station, Amadalavalasa, Srikakulam district, A.P. 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 @ 80:40:40 kg/ha for mesta. The treatments tested 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 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 both all the three seasons. All agricultural practices were done in main and intercrops according to need of crop. Crops were harvested at maturity and proper growth. Yield attributing characters were recorded before harvesting of crop and yield was recorded after harvesting of crop. Economics 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 as per the standard procedures.

Results and Discussion:

Growth Parameters (Table 1): The maximum basal diameter (Table 1) of mesta stem was recorded from Mesta + groundnut (3:4) intercropping (2.06 cm), very closely followed by sole mesta (1.90) and the lowest was observed with the treatment T5. 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 bysole 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)

Mesta Fibre yield (Table 2): Sole crop of Mesta (T1) significantly produced the highest amount (21.59 q/ha) of fibre as compared to mesta intercropped with other crops due to highest plant population when compared with intercropped ones. Among the different intercropping systems the highest mesta fibre yield (16.86 q/ha) was recorded by Mesta + groundnut (3:4) intercropping. Similar findings were reported by Singh *et al*. (2012) and Mandal and Majumdar (2010), whereas the lowest (9.84 q/ha) was observed in Mesta + rice (3:4). The sole crop of groundnut recorded the highest pod yield (32.33 q/ha) when compared with its intercropping with mesta (8.94 q/ha). The highest value of System Mesta Equivalent Yield (SMEY)(33.14 q/ha) was recorded with mesta + groundnut (3:4) intercropping during all three years, while the lowest was recorded with Sole rice (10.56 q/ha), closely followed by Mesta + rice (3:4) intercropping (13.78 q/ha).

Economics (Table 3): The highest net income of Rs.711134 ha^{-1}was recorded undermesta + groundnut (3:4) intercropping with a B:C ratio of 2.59. While the lowest net income of Rs. 2196 ha^{-1} was recorded in Mesta + rice (3:4) intercropping with B: C ratio of 0.96 which is due to very low production of rice as an intercrop in mesta.

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 and Rurinda*et al*. (2014).

Conclusion:

The perusal of data 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 anleguminous crop improved the overall growth of both crops 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.

Table 1: Effect of mesta based 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 greengram	-	-	-

T_5: Sole blackgram	-	-	-
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 + greengram (3:4)	349.5	17.9	209.1
T_9: Mesta + blackgram (3:4)	354.5	18.4	219.8

Table 2: Effect of mesta based inter cropping on yield of mestafibre (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$\pm$				0.95
CD (5%)				2.75
CV %				7.83

Table 3: Economics 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

Table 4: Post-harvest soil fertility status of Mesta 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

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