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Performance of kenaf (*Hibiscus cannabinus* L) genotypes under varying fertilizer levels in rainfed agro-ecosystem of north coastal Andhra Pradesh

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Abstract

Mesta, one of the important fibre crop grown under rainfed conditions with diverse soil types. The present study was conducted to assess the performance of genotypes suitable for the srikakulam and vizianagarm districts of Andhra Pradesh. Therefore, an experiment was conducted under AINP on Jute and Allied Fibre at Agricultural Research Station, Amadalavalasa, ANGRAU. Results indicated that, significant effect of different NPK levels on the growth and yield of new kenaf genotype JRK-2016-5 compared with two check varieties *viz*., AMC 108 and HC 583. The highest fibre and stick yields recorded with combination dose of 60:30:30 NPK kg ha^{-1} by JRK 2016-5. However, highest plant height (302.9 cm) and stick yield were recorded with application of 80:40:40 NPK kg ha^{-1}, but basal diameter (21.3 mm) and fibre yield recorded with application of 60:30:30 NPK kg ha^{-1} to JRK-2016-5 genotype. Economic analysis suggested the best performance of JRK-2016-5 with application of 60:30:30 NPK kg ha^{-1}. The present findings suggested the profitable prospect of nutrient requirement for growth and higher fibre yield of kenaf genotype.

Key words: Fertilizer requirements, Kenaf genotypes, fibre yield, B:C ratio

Mesta, one of the important multipurpose fibre crop adoptive to diverse climatic conditions and soil. It is an herbaceous annual plant comprising two major cultivated species namely Kenaf and Roselle belonging to Malvaceae family. Among these two species, Kenaf (*Hibiscus cannabinus* L), is grown in diverse soil types (Saha *et al*., 2010). India is the principal producing country for the Mesta followed by China and Thailand. In India, 0.628 lakh hectares of Mesta is under cultivation during 2017-18 (Directorate of Jute Development, 2018). Out of the total area under cultivation, highest in Bihar (43.8 %) followed by West Bengal (23.2 %) and 10.5 is concentrated in Andhra Pradesh. The productivity of Mesta is however, highest in Bihar (24.52 q/ha), West Bengal (22.02 q/ha), Andhra Pradesh (15.67 q/ha) and Tripura (15.34 q/ha Srikakulam and Viziayanagaram districts of A.P comprising 0.066 lakh hectares with an average productivity of 1567 kg/ha (Directorate of Jute Development, 2018).

The fibre extracted from kenaf is use for multiple purposes such as making coarse bags, blended with synthetic fibre for making ropes, carpets, nets etc. (Saha *et al.,* 2010). Small and marginal farmers cultivate the kenaf under rainfed, marginal lands in the region (Sreelatha and Raju, 2004). Generally, the productivity of kenaf is higher and it is fast growing compared to roselle under rainfed conditions. But, the pro-

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ductivity of kenaf genotypes is significantly influenced by the nutrient management. Poor nutrient supply hinders the productivity potential of kenaf. To meet the increasing demand for fibre and also to expand the area under kenaf, new genotypes are most necessary. Therefore, the supply of required quantity of inorganic nutrients besides improving the yield levels also maintains the soil fertility. However, the information on the nutrient / fertilizer management schedules for achieving higher productivity in kenaf is meagre. In this context, a study was undertaken to determine the optimum levels of NPK nutrient requirement for the new genotypes under adaptive trials for increased productivity of kenaf crop.

Materials and Methods

The field experiment was conducted during *kharif*, 2021 in sandy clay loam soil at Agricultural Research Station, Amadalavalasa ANGRAU, Andhra Pradesh under All India Network Project on Jute and Allied Fibres (AINPJAF), Barrackpore, Kolkata. Geographically, the experimental field is situated at latitude / longitude of 18.4°N, 83.89°E with an altitude of 35 m above mean sea level. The soil of the experimental field was sandy clay loam in texture. The pre sowing soil fertility status of the experimental field was, soil pH (6.22), EC (0.03 d S/m), organic carbon (0.51%) and available nitrogen, phosphorus and potassium 188, 22.9 and 370 kg/ha, respectively. Average rainfall received during the cropping year was 963.2 mm (Fig. 1).

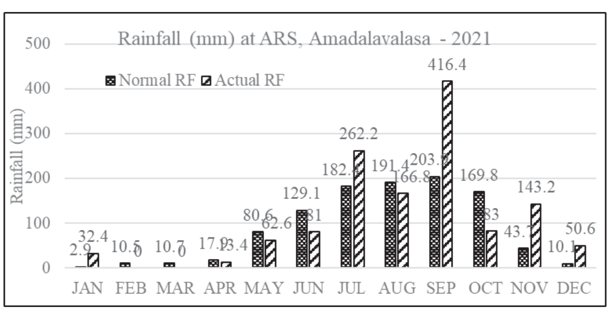

Fig. 1. Rainfall received during the crop growth period at ARS, Amadalavalasa

The experiment was laid out in factorial randomized block design with three replications. The treatments comprising two factors, where genotype [V1: JRK 2016 -5; V2: AMC 108 (check) and V3: HC 583 (check)] were assisted in main plots; and fertilizer schedule (F1: Control; F2: 60:30:30 NPK kg ha^{-1}; F3: 80:40:40 NPK kg ha^{-1} and F4: 100: 50: 50 NPK kg ha^{-1}) were assisted in sub plots. Sources of nitrogen, phosphorus and potash nutrients were urea, single super phosphate and muriate of potash, respectively. N, P and K fertilizers were applied as basal dose at the time of sowing. The crop was sown in line with row to row spacing of 30 cm and plant to plant 10 cm. kenaf genotypes were sown on June 23rd, 2021. The crop was grown completely under rainfed conditions, weeding and thinning operation was done after 30 days after sowing and harvested at maturity (after 120 days).

An observation on plant height (cm) was recorded at 30 days after emergence (DAE), 60 DAE and at physiological maturity. The basal diameters (mm), dry matter and fibre yield was recorded at harvest. Initial and post-harvest soil samples were collected at 0-15 cm depth, dried under shade, processed and analysed for soil reaction, electrical conductivity, oxidizable organic carbon by Walkley and Black method, available N by alkaline permanganate method, available P by Olsen's method and available K by flame photometer, following standard procedures (Jackson, 1973). Observations recorded for different parameters, statistically analysed using analysis of variance (ANOVA) technique and results were presented at 5 % level of significance (P=0.05).

Results and Discussion

Growth and yield of kenaf genotypes

Experimental results revealed that, application of higher dosage of NPK fertilizers positively influenced the plant height and basal diameter of three kenaf genotypes (JRK 2016-5; AMC 108 and HC 583 during *kharif*, 2021 (Table 1). Among three genotypes of kenaf, highest plant height was recorded in AMC 108 (c) during 30 DAE (109.8 cm) and 60 DAE (183.9 cm), respectively. While, at harvest, HC 583 (302.9 cm) and AMC 108 (302.7 cm) genotypes stood taller than JRK-2016-5 (293.7 cm). with respect to different levels of NPK fertilizer application the plant height ranged from 96.4 to 115.1 cm during 30 DAE, 173.3 to 189.8 cm during 60 DAE and 297.1 to 297.9 cm at harvest. Among different fertilizer level, 100:50:50 (NPK kg ha^{-1}) treated plots produced the tallest plants of 115.1 and 189.8 cm during 30 and 60 DAE, respectively. While 80:40:40 (NPK kg ha^{-1}) plots increased the plant height to 302.1 cm at harvest.

Increase in the plant height and basal diameter of kenaf are accounted for influence of fertilizer application. Response of kenaf genotypes in this study to different NPK rates revealed that, crop can perform optimally if grown with appropriate fertilizer schedules. From the results, with increasing level of NPK the plant height increased and indicated the nutrient responsiveness of kenaf genotypes used in the experiment. Akande *et al.* (2011) reported optimal increase of plant height with increase in fertilizer dose. Besides, the positive response of genotypes to increased dose of fertilizers is attributed to initial low fertility status of soil where the experiment was conducted. The trend of results was in line with the report of Raju and Mitra (2019) in sub-tropical climate of India.

Another important growth parameter of kenaf was basal diameter. Among genotypes, basal diameter ranged from 19.6 to 20.4 mm. however it did not vary significantly. While with the application of different levels of fertilizers diameter ranged from 18.6 to 21.3 mm. significantly higher diameter was recorded in 60:30:30 (NPK kg ha^{-1}) applied plots, followed by 100:50:50 and 80:40:40 (NPK kg ha^{-1}) compared to control (Table 1). The results also suggest that, increased dose of nutrients was responsible for the decrease in basal diameter but optimum supply of nutrients increased the diameter compared to control. The findings of Olanipekun *et al.* (2020) showed that applying more dose of fertilizer than required by the genotype could lead to leaching and other losses hence reduce influence of fertilizer on stem girth of kenaf.

Fibre yield of kenaf genotype JRK 2016-5 was 16.42 q ha^{-1} and which is on par fibre yield (3.2% higher) of AMC 108 (15.91 q ha^{-1}) and significantly higher fibre yield (10.1%) than HC 583 (14.91 q ha^{-1}) (Table 1). Similarly, stick yield of JRK-2016-5 (125.7 q ha^{-1}) is on par with HC 583 and lowest stick yield by AMC 108. Application of different levels of NPK fertilizer showed significant effect on fibre and stick yield on genotypes. Fibre yield was ranged from, 14.58 to 16.89 q ha^{-1}, highest fibre yield of 16.89 q ha^{-1} recorded with application of 60:30:30 followed by 80:40:40 with 15.19 q ha^{-1} and 15.57 q ha^{-1} with the application of 100:50:50 NPK kg ha^{-1} compared to lowest (14.58 q ha^{-1}) in control. Similarly, the stick yield ranged from 114.6 to 130.5 q ha^{-1}. Highest stick yield of 130.5 q ha^{-1} recorded with application of 80:40:40 followed by 129.2 q ha^{-1} with 60:30:30 and 120.7 q ha^{-1} in control. However, the lowest stick yield

Table 1. Effect of different levels of NPK on plant height (cm) and basal diameter (mm) of kenaf genotypes.

Treatments	Plant height (cm)			Basal diameter (mm) at harvest	Fibre yield (q ha^{-1})	Stick yield (q ha^{-1})
	30 DAE	60 DAE	At harvest			
Kenaf genotype / variety						
V1: JRK 2016 - 5	104.6	179.8	293.7	20.4	16.42	125.7
V2: AMC 108	109.8	183.9	302.7	19.6	15.91	118.3
V3: HC 583	108.1	182.9	302.9	19.8	14.91	127.2
SEm±	2.59	3.79	3.78	0.34	0.37	3.6
LSD (P = 0.05)	NS	NS	NS	NS	1.09	NS
Fertilizer Schedule						
F1: Control	96.4	173.3	297.1	18.6	14.58	120.7
F2: 60:30:30 NPK kg ha^{-1}	107.6	181.9	301.9	21.3	16.89	129.2
F3: 80:40:40 NPK kg ha^{-1}	110.9	183.8	302.1	19.8	15.92	130.5
F4:100:50:50 NPK kg ha^{-1}	115.1	189.8	297.9	20.0	15.57	114.6
SEm±	2.99	4.37	4.36	0.38	0.43	4.16
LSD (P = 0.05)	8.83	NS	NS	1.41	1.26	12.3

• DAE: Days After Emergence

recorded in higher dose of NPK application which was at the rate of 100:50:50 NPK kg ha^{-1}.

Both the fibre and stick yield of kenaf genotypes increased with increase in application of fertilizer. However, fibre yield of genotype JRK 2016-5 was significantly higher compared to AMC 108 and HC 583. On the other hand, stick yield among genotypes did not vary significantly. Whereas, fibre and stick yield was significantly higher with application of 60:30:30 followed by 80:40:40 and 100:50:50 NPK kg ha^{-1}. Stick yield is significantly lower with higher level of NPK application. Results revealed that, interaction of genotypes with varying fertilizer levels were non-significant. However, genotype JRK 2016-5 recorded higher fibre yield compared to other two genotypes. Olanipekun *et al.* (2020) reported that, kenaf does not require higher dose of NPK fertilizer. The low yield of kenaf fibre and stick yield under higher NPK fertilizer dose as reflected in the present study may be attributed to nature of soil in the experimental site and other environmental factors.

However, the results from the present study suggest that, application of optimal dose of NPK fertilizer increases the fibre yield and the increase depends on soil factors. Olanipekun *et al.* (2021) opined that, application of higher dose of NPK fertilizer to sandy soil which is poor in water holding capacity, low cation exchange capacity and erratic rainfall of the region could result in nutrient losses, intern influences the kenaf yields. Hence, the yields were not on par with higher yields of other regions. However, Ullah *et al.* (2017) observed that, application of optimum dose of NPK fertilizer resulted in higher yield of fibre and stick yield as compared to control.

Soil fertility status

The post-harvest soil fertility status after *kharif* season showed significant variations in nutrient content due to impact of various treatments. Application of different NPK levels to kenaf genotypes revealed that, pH of post-harvest soil decreased significantly compared to control. Lowest pH was with the application of 100:50:50 NPK kg ha^{-1}. Electrical conductivity of soil decreased but not significant. However, organic carbon content significantly decreased and recorded lowest with 80:40:40 NPK kg ha^{-1}, while available nitrogen and phosphorus increased significantly with higher dose of fertilizers (80:40:40 and 100:50:50 NPK kg ha^{-1}). But the available potassium content decreased significantly in the post-harvest soil with different levels of fertilizers applied. The decrease in soil reaction might be due to higher level of inorganic fertilizer applied and decrease in available potassium might be attributed to plant uptake (Saha *et al.*, 2010; Raju and Mitra, 2019).

Among three genotypes cultivated, lowest decrease of the pH, EC, organic carbon, available nitrogen and potassium content in post-harvest soil was recorded with JRK 2016-5. However, the

Table 2. Effect of different levels of NPK on post-harvest soil fertility status.

Treatments	pH	EC (d Sm^{-1})	OC (%)	Aval. N (kg/ha)	Aval. P_2O_5 (kg/ha)	Aval. K_2O (kg/ha)
Kenaf genotype / variety						
V1: JRK 2016 -5	5.19	0.02	0.41	201	23.6	288
V2: AMC 108	5.08	0.02	0.39	205	24.9	249
V3: HC 583	5.10	0.03	0.37	181	23.3	232
SEm±	0.07	NS	0.02	11.7	NS	16.1
LSD (P = 0.05)	0.02	0.002	0.01	3.97	0.48	5.48
Fertilizer Schedule						
F1: Control	5.17	0.02	0.42	161	20.6	267
F2: 60:30:30 NPK kg ha^{-1}	5.22	0.02	0.38	189	21.3	256
F3: 80:40:40 NPK kg ha^{-1}	5.10	0.02	0.37	213	27.8	244
F4:100:50:50 NPK kg ha^{-1}	5.00	0.02	0.39	219	26.0	259
SEm±	0.03	0.002	0.01	4.58	0.55	6.32
LSD (P = 0.05)	0.08	NS	0.02	13.5	1.6	NS

• OC, organic carbon; EC, electrical conductivity; NS, non-significant

Table 3. Economics of fertilizer management for kenaf genotypes

Treatment	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C
Kenaf genotype / variety				
V1: JRK 2016 -5	45678	73868	28190	1.62
V2: AMC 108	45678	71581	25903	1.57
V3: HC 583	45678	67069	21392	1.47
Fertilizer Schedule				
F1: Control	41518	65630	24112	1.58
F2: 60:30:30 NPK kg ha^{-1}	45537	76009	30472	1.67
F3: 80:40:40 NPK kg ha^{-1}	46930	71660	24730	1.53
F4:100:50:50 NPK kg ha^{-1}	48726	70059	21333	1.44

same genotype grown plot recorded phosphorus build up as compared to other two genotypes. Genotypes, HC 583 required more nutrients and reflected in post-harvest soil nutrient status followed by AMC 108 and JRK 2016-5. Similarly, Ali *et al.* (2017) reported the optimum requirement of nutrients for the performance of kenaf crop.

Economic analysis

The economic performance is a prime need for kenaf cultivation by any farmer in any region (Ali *et al*., 2017). Small and marginal farmers in the rainfed region of Srikakulam and Vizianagaram districts of Andhra Pradesh are still directly connected with the cultivation of kenaf crop. Therefore, the economic analysis was made considering the variable cost of fertilizers, labours, seeds and price of fibre and stick (Table 3). Results revealed that, the genotype JRK 2016-5 was the most cost effective with the application of 60:30:30 NPK kg ha^{-1}as it gives the highest gross return, net return with highly profitable benefit cost ratio.

Conclusion

All the three levels of fertilizer application compared with control influenced the growth and yield of kenaf genotypes. Among the three levels of NPK application, 60:30:30 NPK kg ha^{-1} found optimum and suitable dose of fertilizer for kenaf. Considering the most valuable yield of fibre and stick as well as the profitability of the cultivation, the genotype JRK 2016-5 with 60:30:30 NPK kg ha^{-1} seems to be the best management priority for the north coastal Andhra Pradesh.

References

Akande, M.O., Makinde, E.A., Aluko, O.A., Oluwatoyinbo, F.I. and Adediran, J. A., 2011. Rock phosphate amendment effects on kenaf (*Hibiscus cannabinus* L.) growth and yield. *Tropical and Subtropical Agroecosystems*, **14**: 559–565.

Ali, M.S., Gani, M.N. and Islam, M.M., 2017. Efficiency of BJRI Kenaf-4 yield under different fertilizer levels. *American Journal of Agriculture and Forestry*, **5**(5):145–149.

Jackson, M.L. 1973. Soil chemical analysis, pp485. Prentice Hall of India Pvt, Ltd. New Delhi.

Directorate of Jute Development, 2018. Directorate of Jute Development, Government of India, Ministry of Agriculture and Farmers welfare, Kolkata – 700020.

Olanipekun, S., O Togun, A., and K Adebayo, A., 2020. Influence of NPK fertilizer on growth and nutrient uptake of kenaf (*Hibiscus cannabinus* L.) in south western Nigeria. *European journal of agriculture and forestry Research, 8* (1): 16–27.

Olanipekun, S., O Togun, A., K Adebayo, A. and Anjorin, F.B., 2021. Effects of organic and inorganic fertilizers on the growth and yield of kenaf (*Hibiscus cannabinus* L.) production in South Western Nigeria. *International Journal of Plant and Soil Sciences,* **33**(2): 1–9. http://libraryaplos.com/xmlui/handle/123456789/5009

Raju, M. and Mitra, S., 2019. Studies on growth and yield attributes of different kenaf genotypes influenced by various fertilizer levels. *International Journal of Chemical Studies,* **7**(6):

1964–66.

Saha, A.R., Maitra, D.N., Majumdar, B., Saha, S. and Chowdhury, H. 2010. Response of kenaf (Hibiscus canabinus) to integrated nutrient management in relation to its fibre productivity, nutrient uptake and soil properties. *Indian Journal of Agricultural Sciences,* **80** (2):146–150.

Sreelatha, T. and Raju, K.A. 2004. Latest development for enhancing productivity and improving quality of Mesta in Andhra Pradesh. In: Proceedings of "National seminar on raw jute" organized by CRIJAF and Directorate of Jute Development during April 16-17: 87–92.

Ullah, S., Anwar, S., Rehman, M., Khan, S., Zafar, S., Liu, L. and Peng, D., 2017. Interactive effect of gibberellic acid and NPK fertilizer combinations on ramie yield and bast fibre quality. *Scientific Reports*, **7**(1):1–9.