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Soil fertility and nutrient balance as influenced by potash management through gliricidia green leaf manuring in rainfed cotton on vertisols

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Abstract
A field study was conducted during *kharif* 2019-20 at Research field of AICRP for Dryland Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra to assess the effect of potash management through gliricidia green leaf manuring on soil fertility and yield of rainfed cotton in Vertisols. The soil of the experimental site was Vertisol which was moderately alkaline in reaction, low in available nitrogen, medium in available phosphorus and high in available potassium. The nine treatments replicated three times in randomized block design comprised of control, 100% RDF (60:30:30 NPK kg ha^{-1}), 100%, 75% and 50% N and 100% P through chemical fertilizers and the combinations of 15, 20 and 30 kg K ha^{-1} through gliricidia green leaf manure at 30 DAS and remaining recommended dose of potassium as basal dose through inorganic fertilizers. The results indicated that application of 100% NP + 10 kg K (inorganic) + 20 kg K ha^{-1} through gliricidia green leaf manure at 30 DAS recorded significantly higher cotton yield with improvement in soil fertility and it was found to be on par with application of 100% NP + 15 kg K (inorganic) + 15 kg K ha^{-1} through gliricidia green leaf manure. Hence, it is concluded that conjunctive application of 100% NP + 10 kg K (inorganic) + 20 kg K ha^{-1} through gliricidia green leaf manuring at 30 DAS resulted in improvement in soil fertility and yield of cotton grown in Vertisols under rainfed conditions.

Keywords: Potash management, gliricidia green leaf manuring soil fertility and vertisols

Introduction
Cotton (*Gossypium* spp.) is an important cash crop globally known as "king of fibre" and play vital role in the economy of farmers as well as the country and is popularly known as "white gold". It is a fibre crop originated in India and belongs to Malvaceae family, accounting for around 25% of the total global fibre production. Among different species of cotton *Gossypium hirsutum* and *Gossypium arboreum* are commonly grown in Maharashtra and used in textile industries for manufacture of cloth. India is the largest cotton growing country in the world and occupies 37.5% world cotton area and produces around 24.3% of world cotton production. In 2019-20 area, production and productivity under cotton in India is estimated as 125.84 lakh ha, 360.0 lakh bales of 170 kg and 486 kg ha^{-1} respectively. In India, Maharashtra rank first in acreages with 43.69 lakh ha and 82.0 lakh bales production with average productivity of 319 kg lint/ha (Anonymous, 2020a) [1]. In Maharashtra state, Vidarbha is the largest cotton growing region accounting for 15.81 lakh ha^{-1} acreage with production of 35.5 lakh bales and productivity of 388.0 kg lint ha^{-1} (Anonymous, 2020b) [2].

Integrated plant nutrient management enhances the crop productivity and improves the soil physical, chemical as well as biological properties. The physical properties *viz.* water stable aggregates, mean weight diameter, available water capacity, hydraulic conductivity increases with the application of crop residues along with fertilizers whereas bulk density decreases. The chemical properties namely organic carbon content and available nutrients enhances with the application of crop residues supplemented with chemical fertilizers. The biological properties like SMBC, CO_2 evolution and DHA increases with integrated nutrient management.

Gliricidia sepium is a leguminous multipurpose tree and adopts very well in a wide range of soils. The leaves of gliricidia decompose relatively fast with addition of plant nutrients and organic matter to the soil and increases crop productivity. It plays important role in increasing the fertility status of soils and helps in conserving soil through reduced soil erosion also. Patil (1989) [10] stated that 1 tonne dry weight of leaves was equivalent to 27 kg N while, Kang and

Mulongoy (1987) [4] reported that upto 15 t/ha/year of gliricidia leaf biomass could be produced on good soils in Nigeria providing the equivalent of 40 kg N/ha/year. Application of 1 t ha^{-1} gliricidia leaf manure provides 21 kg N, 2.5 kg P, 18 kg K, 85 g Zn, 164 g Mn, 365 g Cu, 728 g Fe besides considerable quantities of S, Ca, Mg, B, Mo etc.(Wani *et al*., 2009) [21].

It is essential to build up the organic matter status of the soil by using various available organic resources. Therefore, more logical way to manage long term soil fertility and crop productivity is by integrated use of inorganic and organic sources of plant nutrients and adoption of conservation tillage.

Materials and Methods

A field experiment conducted on Vertisols was initiated on the research field of AICRP for Dryland Agriculture, Dr. PDKV, Akola since 2015-16. The present study was undertaken during 2019-20 with nine treatments replicated three times in randomized block design. The treatments comprised of control, 100% RDF (60:30:30 NPK kg ha^{-1}), 100%, 75% and 50% N and 100% P through chemical fertilizers and the combinations of 15, 20 and 30 kg K ha^{-1} through gliricidia green leaf manure at 30 DAS and remaining recommended dose of potassium as basal dose through inorganic fertilizers.

Results and Discussion

Organic carbon

Soil organic carbon is an indication of organic carbon fraction of soil formed due to microbial decomposition of organic residues. The data pertaining to the organic carbon content of soil as influenced by different treatments was statistically significant (Table 1) and it ranged from 0.51 to 0.66% indicating that the highest (0.66%) organic carbon was recorded with the application of 100% NP + 10 kg K (inorganic) + 20 kg K ha^{-1} through gliricidia (T_4) and it was found to be on par with application of 100% NP + 15 kg K (inorganic) + 15 kg K ha^{-1} through gliricidia (T_3),application of 100% NP + 30 kg K ha^{-1} through gliricidia (T_5) and treatment receiving 100% RDF (60:30:30 NPK kg ha^{-1}) (T_2). The increase in organic carbon content was 0.15% and 0.07% higher with application of 100% NP + 10 kg K (inorganic) + 20 kg K through gliricidia (T_4) as compared to control (T_1) and 100% RDF (T_2) treatments respectively. The lower value (0.51%) of organic carbon was found in treatment T_1 *i.e.* control.

Table 1: Effect of potash management through gliricidia green leaf manuring on organic carbon status in soil

	Treatments	OC (%)	OC balance (%)
T_1	Control	0.51	0.00
T_2	100% RDF (60:30:30 NPK kg ha^{-1})	0.59	0.08
T_3	100% NP + 15 kg K (inorganic) + 15 kg K through gliricidia	0.63	0.12
T_4	100% NP + 10 kg K (inorganic) + 20 kg K through gliricidia	0.66	0.15
T_5	100% NP + 30 kg K through gliricidia	0.65	0.14
T_6	75% N + 100% P + 15 kg K (inorganic) + 15 kg K through gliricidia	0.57	0.06
T_7	75% N + 100% P + 30 kg K through gliricidia	0.57	0.06
T_8	50% N + 100% P + 30 kg K through gliricidia	0.58	0.07
T_9	100% K through gliricidia	0.55	0.04
SE (m) ±		0.03	-
CD at 5%		0.08	-

The higher values of organic carbon content with application of gliricidia green leaf manuring may be attributed to addition of organic materials and greater root biomass with their addition as evidenced from the higher yields obtained in these treatments. Similar results were also reported by Tolanur and Badanur (2003) [17], Vaiyapuri *et al.* (2008) [18], Kumar *et al.* (2008) [7], Regar *et al*. (2009) [12], Surekha and Rao (2009) [16], Hababi *et al.* (2013) [3], Naik *et al.* (2018) [8], Satpute *et al.* (2019) [13], Shelke *et al.* (2019) [14] and Yadav *et al.* (2019) [22].

Organic carbon balance

The data in respect of organic carbon balance (Table 1) indicate the higher gain of 0.15% in treatment receiving 100% NP + 10 kg K (inorganic) + 20 kg K through gliricidia (T_4) followed by treatments receiving 100% NP + 30 kg K through gliricidia (T_5) and 100% NP + 15 kg K (inorganic) + 15 kg K through gliricidia (T_3).

Soil water and temperature are the limiting factors of the dryland agriculture and have direct influence on the soil organic carbon. Natural incorporation of the crop residues in to the soil after harvest of the crop is common phenomenon, but year after year, continuous addition of the crop residues or green manuring or even FYM has a very little effect on soil organic carbon in dryland condition. The data on potash management through gliricidia green leaf manuring showed the improvement and maintenance of the soil organic carbon content in dryland agriculture as a result of judicious use of gliricidia green leaf manure in combination with the inorganic fertilizers. Use of organic or inorganic plant nutrient sources alone was not helpful in significant build-up of organic carbon in soils under dryland condition.

Available Nitrogen

The results pertaining to available N status of soil (Table 2) was significantly influenced by different treatments. The available N in soil varied from 186.07 to 219.52 kg ha^{-1} indicating that the soil was low in available N content. The higher available N (219.52 kg ha^{-1}) was observed with the application of 100% NP + 10 kg K (inorganic) + 20 kg K ha^{-1} through gliricidia (T_4) and it was found to be on par with treatment receiving 100% NP + 15 kg K (inorganic) + 15 kg K ha^{-1} through gliricidia (T_3) and treatment with application of 100% NP + 30 kg K ha^{-1} through gliricidia (T_5). It was also noted that 18.0% and 9.4% increase in available N content was recorded in treatment T_4 as compared to control (T_1) and 100% RDF (60:30:30 NPK kg ha^{-1}) (T_2) respectively. The lower value (186.07 kg ha^{-1}) of available N was found in treatment T_1, *i.e.* control.

The increase in available N due to incorporation of gliricidia green leaf manuring may be due to higher amount of nitrogen content in these leaves and the favourable soil conditions under green leaf manuring might have helped the mineralization of soil N leading to build-up of higher available N. Similar results were also given by Vats *et al.* (2001) [19], Katkar *et al.* (2006) [5], Vaiyapuri *et al.* (2008) [18], Vidyavathi *et al.* (2011) [20], Rajashekarappa *et al.* (2013) [11], Naik *et al*. (2018) [8], Satpute *et al.* (2019) [13], Shelke *et al*. (2019) [14] and Yadav *et al*. (2019) [22].

Available Phosphorus

It is evident from the data in Table 2 that available P content of soil varied significantly and it ranged from 12.02 to 18.07 kg ha^{-1} indicating that the soil was low to medium in available phosphorus content. The highest (18.07 kg ha^{-1}) available P was found with the application of 100% NP + 10 kg K (inorganic) + 20 kg K ha^{-1} through gliricidia (T_4) and it was found to be on par with the application of 100% NP + 15 kg K (inorganic) + 15 kg K ha^{-1} through gliricidia (T_3) and treatment with application of 100% NP + 30 kg K ha^{-1} through gliricidia (T_5). It is noted that 50.3% and 15.2% increase in available P content was recorded in treatment T_4 as compared to control (T_1) and 100% RDF (60:30:30 NPK kg ha^{-1}) (T_2) respectively. The lower value of available P was found in treatment T_1, *i.e.* control (12.02 kg ha^{-1}).

The higher content of available P may be due to the application of potassium through gliricidia green leaf manuring which increases the availability of phosphorus in the soil. During decomposition of green manure, various organic acids are produced which solubilize phosphatase and other phosphate bearing minerals and thereby lowers the phosphate fixation and increase its availability.

Simllar results were recorded by Padole *et al.* (1998) [9], Katkar *et al*. (2002) [6], Vaiyapuri *et al*. (2008) [18], Shirale and Khating (2009) [15], Vidyavath *et al*. (2011) [20], Naik *et al*. (2018) [8], Satpute *et al.* (2019) [13], Shelke *et al*. (2019) [22] and Yadav *et al*. (2019) [14].

Available Potassium

The black soils developed from basalt have the major quantity of the mineral feldspar which is rich in K, Na and Ca, hence potash fertilizers are not recommended for the crops grown on black soils.

Table 2: Effect of potash management through gliricidia green leaf manuring on soil fertility

Treatments		Avail. Nutrients (kg ha^{-1})		
		N	P	K
T_1	Control	186.07	12.02	318.12
T_2	100% RDF (60:30:30 NPK kg ha^{-1})	200.70	15.68	343.84
T_3	100% NP + 15 kg K (inorganic) + 15 kg K through gliricidia	213.25	17.32	355.23
T_4	100% NP + 10 kg K (inorganic) + 20 kg K through gliricidia	219.52	18.07	368.85
T_5	100% NP + 30 kg K through gliridia	211.16	17.55	356.53
T_6	75% N + 100% P + 15 kg K (inorganic) + 15 kg K through gliricidia	204.89	16.43	346.08
T_7	75% N + 100% P + 30 kg K through gliricidia	202.79	16.13	334.88
T_8	50% N + 100% P + 30 kg K through gliricidia	200.70	15.98	327.41
T_9	100% K through gliricidia	198.61	14.63	324.80
SE (m) ±		4.48	0.53	7.63
CD at 5%		13.42	1.59	22.88

The swelling and shrinkage property of black clayey soils trap the K ions in crystal lattice. The data on available K content of soil varied significantly from 318.12 to 368.85 kg ha^{-1} indicating that soil was high to very high in available K content. The highest available K (368.85 kg ha^{-1}) was observed with the application of 100% NP + 10 kg K (inorganic) + 20 kg K ha^{-1} through gliricidia (T_4) and it was found to be on par with the application of 100% NP + 15 kg K (inorganic) + 15 kg K ha^{-1} through gliricidia (T_3), application of 100% NP + 30 kg K through gliricidia (T_5) and treatment receiving 75% N + 100% P + 15 kg K (inorganic) + 15 kg K through gliricidia (T_6). It was also noted that 15.9% and 7.3% increase in available K content was observed in treatment T_4 as compared to control (T_1) and 100% RDF (60:30:30 NPK kg ha^{-1}) (T_2) respectively. The lower value of available K was found in absolute control treatment *i.e.* T_1 (318.12 kg ha^{-1}).

Nutrient balance

The data on nutrient (N, P & K) balance as influenced by various treatments are presented in Table 3. However, the higher gain of nitrogen (33.7 kg ha^{-1}) was recorded with the application of 100% NP + 10 kg K (inorganic) + 20 kg K ha^{-1} through gliricidia (T_4) followed by T_3 (27.4 kg ha^{-1}). The results revealed that, the combined use of nitrogen sources *i.e.* fertilizer and organic matter is essential for improvement in available N content of soil.

Table 3: Effect of potash management through gliricidia green leaf manuring on nutrient balance in soil

Treatment	Nutrient status at the end (2019-20) (kg ha^{-1})			Net gain(+)/Loss(-) (kg ha^{-1})		
	N	P	K	N	P	K
T_1	186.07	12.02	318.12	0.3	-2.6	-3.9
T_2	200.70	15.68	343.84	14.9	1.1	21.8
T_3	213.25	17.32	355.23	27.4	2.7	33.2
T_4	219.52	18.07	368.85	33.7	3.5	46.9
T_5	211.16	17.55	356.53	25.4	2.9	34.5
T_6	204.89	16.43	346.08	19.1	1.8	24.1
T_7	202.79	16.13	334.88	17.0	1.5	12.9
T_8	200.70	15.98	327.41	14.9	1.4	5.4
T_9	198.61	14.63	324.80	12.8	0.03	2.8
Initial (2015-16)	185.80	14.60	322.00	-	-	-

The data in respect of phosphorus balance (Table 3) indicate the gain of phosphorus in all the treatments except control.

Gliricidia was used as organic source in combination with inorganic fertilizers in all other treatments except control treatment. However, the higher gain of phosphorus was recorded in treatment T_4 (3.5 kg ha^{-1}) followed by T_5 (2.9 kg ha^{-1}).

The data in respect of potassium balance (Table 3) indicate the gain of potassium in all the treatments except control. However the higher gain was noticed in treatment T_4 (46.9 kg ha^{-1}) followed by treatment T_5 (34.5 kg ha^{-1}) where gliricidia was used as organic source in combination with inorganic fertilizers.

In general, the data on nutrient balance indicated that the higher gain of available nutrients *viz.*, nitrogen, phosphorus and potassium were recorded with the application of 100% NP + 10 kg K (inorganic) + 20 kg K through gliricidia (T_4) followed by treatments T_5 and T_3, indicating the significant role of gliricidia green leaf manuring in nutrient dynamics.

Conclusion

The conjunctive application of 100% NP + 10 kg K (inorganic) + 20 kg K ha^{-1} through gliricidia green leaf manuring at 30 DAS resulted in higher organic carbon pools with improvement in soil fertility and yield of cotton grown in Vertisols under rainfed conditions.

References

1. Anonymous. ICAR AICRP (Cotton) Annual Report (2019-20), Coimbatore, Tamil Nadu, India 2019-20a.
2. Anonymous. http://krishi.maharashtra.gov.in, Department of Agriculture, Govt. of Maharashtra 2019-20b.
3. Hababi Armin, Javanmard Abdollah, Bahman Mosavi Seyed, Rezaei Mohammad, Sabaghnia Naser. Effect of green manure on some Soil physico-chemical characteristics. International Journal of Agronomy and Plant Production 2013;4(11):3089-3095.
4. Kang BT, Mulongoy K. Gliricidia sepium as a source of green manure in an alley cropping system. In: Withington, D, Glover, N and Brewbaker, JL (eds), Gliricidia sepium (Jacq.) Walp: Management and Improvement, Proceedings of a workshop at CATIE, Turialba, Costa Rica. NFTA Special Publication 1987;87(01):44-49.
5. Katkar RN, Turkhede AB, Wankhede ST. Residual effect of manures and inorganic fertilizer on soil properties and yield of cotton. PKV Research Journal 2006;30(1):36-41.
6. Katkar RN, Turkhede AB, Solanke VM, Wankhade ST, Patil MR. Effect of integrated management of organic manures and fertilizer on soil properties and yield of cotton. Journal of Cotton Research and Development 2002;16(1):89-92.
7. Kumar B, Gupta RK, Bhandari AL. Soil fertility changes after long-term application of organic manures and crop residues under rice-wheat system. Journal of the Indian Society Soil Science 2008;56(1):80-85
8. Naik Rajesh K, Gabhane VV, Chandel Ashwini, Nagdeve MB. Soil fertility and cotton productivity as influenced by potash management through gliricidia green leaf manuring in Vertisols. Special issue ICAAASTSD-2018. Multilogic in Science 2018;VII:207-209.
9. Padole VR, Deshmukh PW, Nikesar RJ, Bansode NV. Effect of organics and inorganics on yield and quality of cotton grown on Vertisol. PKV Research Journal 1998;22(1):6-8.
10. Patil BP. Cut down fertilizer nitrogen need of rice by Gliricidia green manure. Indian farming 1989;39:34-35.
11. Rajashekarappa KS, BE, Puttaiah ET. Effect of different organic mulches and in-situ green manuring on soil properties and yield and economics of maize in south-eastern dry zone of Karnataka. Global Journal of Biology Agriculture and Health Science 2013;2(3):236-240.
12. Regar PL, Rao SS, Vyas SP. Crop residue management for sustainable production of Indian mustard (Brassica juncea) in arid and semi arid region. Indian Journal of Soil Conservation 2009;37(2):118-122.
13. Satpute Usha V, Gabhane VV, Jawale SA, Jadhao VH. Impact of potash application through glyricidia green leaf manuring on yield and nutrient uptake by cotton in Vertisols. Journal of Pharmacognosy and Phytochemistry 2019;8(3):4111-4114.
14. Shelke A, Gabhane VV, Yadav J, Ganvir MM, Jadhao SD. Effect of long term integrated nutrient management on carbon pools and their relationship with yield of cotton + greengram (1:1) intercropping system in vertisols. International journal of chemical studies 2019;7(4):1862-1867.
15. Shirale ST, Khating LE. Effect of organic and inorganic nutrients on yield, nutrient uptake and balance in different cropping systems in Vertisol. Annals of Plant Physiology 2009;23(1):83- 85.
16. Surekha K, Rao KV. Direct and residual effect of organic sources on rice productivity. Journal of the Indian Society of Soil Science 2009;57(1):53-57.
17. Tolanur SI, Badanur VP. Effect of integrated use of organic manure, green manure and fertilizer nitrogen on sustaining productivity of rabi sorghum-chickpea system and fertility of a Vertisol. Journal of the Indian Society of Soil Science 2003;51:41-44.
18. Vaiyapuri K, Amanullah MM, Somasundaram E, Sathyamoorthi K, Pazhaznivelan S. Post harvest soil chemical and physical properties and cotton yield as influenced by intercropping unconventional green manuring in cotton. Green Farming 2008;2(1):47.
19. Vats MR, Sehgal DK, Mehta DK. Integrated effect of organic and inorganic manuring on yield sustainability in long term fertilizer experiment. Indian Journal of Agricultural Research 2001;35(1):19-24.
20. Vidyavathi GS, Babalad Dasog B, Hebsur NS, Gali SK, Patil SG, Alagawadi AR. Influence of nutrient management practices on crop response and economics in different cropping systems in a Vertisol. Karnataka Journal of Agricultural Science 2011;24(4):455-460.
21. Wani SP, Sreedevi TK, Rockström J, Ramakrishna YS. Rainfed Agriculture-Past trend and future prospectus. In: Wani SP, Rockstrom J and Oweis T (eds). Rainfed agriculture: Unlocking the Potential. Comprehensive Assessment of Water Management in Agriculture Series. CAB International, Wallingford, UK 2009,1-35p.
22. Yadav Jaipal, Gabhane VV, Shelke Ajay, Patode RS, Rathod Arti. Effect of potash management through Gliricidia green leaf manuring on potassium fractions and their relationship with yield of soybean in Vertisols. International Journal of Chemical Studies 2019;7(4):1072-1076.