Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; SP1: 64-68

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Comparative study of soil fertility status of direct seeded and transplanted rice under Kohima district of Nagaland

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Abstract

In the present investigation, soil fertility status of directed seeded and transplanted rice under Kohima district of Nagaland were studied. The soils of the study area were strong to moderate acidic in reaction with pH ranged from 4.94 to 5.58 and EC ranged from 0.04 to 0.15 dSm^{-1}, respectively. The soils were high in organic carbon and potassium. Organic carbon ranged from 0.80 to 2.02 (%) and potassium ranged from 279.6 to 520.4 kg ha^{-1}, respectively. The available nitrogen, phosphorus and sulphur ranged from low to medium, respectively.

Keywords: Soil fertility status, land use system, rice soil

Introduction

Continuous cropping for enhanced yield removes substantial amounts of nutrients from soil. Imbalance and inadequate use of chemical and fertilizers, improper irrigation and various cultural practices also deplete the soil quality rapidly (Medhe *et al*. 2012) [15]. Soil fertility fluctuates throughout the growing season each year due to alteration in the quality and availability of mineral nutrients by the addition to leaching. Evaluation of fertility status of the soils of an area or a region is important aspect in the context of sustainable agriculture (Singh and Mishra, 2012).

In upland areas, the crop gets setback mostly due to drought condition and it is not because of insufficient rain but poor management and lack of irrigation channels to bring the water from the source. It has also been observed that some types of soils do not respond to the application of N, P and K due to some inherent characteristics. In certain areas, non-availability of suitable high yielding varieties and quality seeds also contribute to a great extent to the constraints in rice production. The rice production in Nagaland scenario seems non-significant at National level. The productivity of rice is very low.

A precise spatially explicit knowledge about the soil fertility status through local studies of the field is essential to guide sustainable intensification in agriculture. This study is meagre and no work has been done in this field in Nagaland. Therefore an attempt was made to investigate the "Comparative study of soil fertility status of direct seeded and transplanted rice under Kohima district of Nagaland".

Methods and materials

The soil samples used in the study covered 50 upland rice areas out of which 25 sample were under Transplanted rice (TERRACE) and 25 samples under dry direct seeded rice (JHUM). The samples were collected in the month of March and April, year 2016. The strata of farmers were small to marginal and the farmers did not apply any form of fertilizers in the rice field. Nagaland lies in the sub-alpine climate with an average rainfall of 2000-2500 mm per annum. The temperature of Nagaland in summer varies between 16°C to 31°C and in winter it varies between 4°C to 24°C. The district is located between the geographical co-ordinate of 25.40°N latitude and 94.88° E latitude. Fifty surface (0-15cm) soil samples from Transplanted and dry direct seeded rice fields was collected from different villages under Kohima district namely Rousoma, Kohima village, Jotsoma, Kigwema, Jakhama, Zubza (Sechu), Tsonsa, Likhwenchu, Nsunyu, Chunlika. The soil pH was derermined in 1:2.5 soil:water suspension using glass electrode meter Richards (1954). Electrical conductivity was determined in 1:2 soil:water suspension using conductivity bridge and expressed as dSm^{-1} Richards (1954). The organic carbon of the soil sample was determined by rapid titration method advocated by Walkely and Black method and expressed in percentage as described by Jackson (1973) [10]. Available nitrogen was determined using alkaline potassium permanganate method as given by

Subbiah Asija (1956) [34]. The available phosphorus was determined by Bray and Kurtz method (Bray and Kurtz, 1945) [6]. The available potassium was determined by flame photometer (Hanway and Heidal, 1952). The available sulphur was determined by turbidimetric method using a spectrophotometer or colorimeter (Ensminger, 1954).

Results and Discussion

Soil reaction

The data presented (Table1) revealed the pH values of the soils of different villages under dry direct seeded and transplanted (Terrace) land use system. The villages under dry direct seeded (Jhum) land use namely Chunlika, Nsunyu, Likhwenchu, Rusoma and Tsonsa. The pH values range was found from 4.94 to 5.14 with the average value 5.06. On the basis of average mean value Rusoma village showed the highest pH with 5.14 and the lowest by Chunlika village with pH 4.94. The villages under transplanted (Terrace) land use namely Jakhama, Jotsoma, Kigwema, Kohima and Zubza. The pH values range was found 5.22 to 5.58 with the average value 5.41. On the basis of average value, Kohima village showed the highest pH with 5.58 and the lowest under Zubza village with 5.22. Similar results have been reported by Datta and and Gupta (1983) [8], Kire (1992) [13], Patton *et al.* (2005) [22], Singh and Bordoloi (2011) [31], Sharma *et al.* (2012) [29], Jayanthi *et al.* (2015) [11] for the soils in some other North-Eastern regions. The pH varied with variation in land use systems. Similar results were also found by Sannigrahi and Pandey (2000) [25], Nayak and Srivastava (1955) [19] and Chakraborty *et al.* (1984) [7].

Electrical Conductivity

The data presented in table 1 revealed the soil EC value of the soil samples on the basis of land use system viz. dry direct seeded (Jhum) and transplanted (Terrace) fields. The villages under dry direct seeded land use are Chunlika, Nsunyu, Likhwenchu, Rusoma and Tsonsa. The result revealed that the EC value of soil in dry direct seeded rice field varied from 0.05 to 0.12 dSm^{-1} with a mean value of 0.076 dSm^{-1}. The highest EC value 0.12 dSm^{-1} was recorded under Chunlika village and the lowest (0.05 dSm^{-1}) under Tsonsa village. The villages under transplanted land use are Jakhama, Jotsoma, Kigwema, Kohima and Zubza, which have EC values ranging from 0.04 to 0.15 dSm^{-1} with an average value of 0.078 dSm^{-1}. On the basis of average value Kohima village showed the highest EC with 0.15 dSm^{-1} and the lowest under Zubza village with 0.04 dSm^{-1}. Similar findings have been reported by Pillai and Natarajan (2004), Kher and Khajuria (2005) [12], Sharma *et al.* (2012) [29], Jayanthi *et al.* (2015) [11].

Soil organic carbon

On the basis of land use system viz. dry direct seeded (Jhum) and transplanted (Terrace) fields, the data presented (Table1) the soil organic carbon percentage value of the soil samples. The villages under dry direct seeded land use namely Chunlika, Likhwenchu, Nsunyu, Rusoma and Tsonsa, whereas the villages considered under transplanted land use system namely Jakhama, Jotsoma, Kigwema, Kohima and Zubza. The data revealed that the variation in percent of organic carbon with 2.02 to 1.82, mean value of 1.92 under soils of dry direct seeded, whereas variation was recorded 0.8 to 1.54 with mean value 1.24 under transplanted rice fields. Highest organic carbon was recorded as 2.02 under by Chunlika village and lowest as 1.8 under Likhwenchu village, under dry direct seeded whereas highest 1.54 by Kohima and lowest 0.8 by Jotsoma village under transplanted rice fields. The relatively lower temperature prevalent in this region might have reduced the rate of decomposition of organic matter and has contributed to the significant content of organic carbon in the soil. High content of organic carbon was also reported by Sarkar (2009) [26]. Organic matter is the primary source of organic carbon in the soil and gets accumulated in the top soil (Brady, 1996) [5]. The present study recorded high OC content in all the samples. This results are in agreement with those reported by Sharma (2013) [28], Jayanthi *et al*. (2015) [11], Namei *et al*. (2016) [18].

Available Nitrogen

The available nitrogen in the rice fields recorded to be higher in dry direct seeded than in transplanted rice field as presented in table2. The average available nitrogen values range was recorded under dry direct seeded land use viz. Chunlika, Likhwenchu, Nsunyu, Rusoma and Tsonsa, whereas the villages considered under transplanted land use system namely Jakhama, Jotsoma, Kigwema, Kohima and Zubza. In dry direct seeded fields the highest value 298.5 kg ha^{-1} was reported from Tsonsa village and lowest 205.7 kg ha^{-1} was reported from Chunlika village whereas in transplanted fields the highest value of 278.4 kg ha^{-1} was reported by Jotsoma village and lowest 205.7 kg ha^{-1} by Zubza village, indicating that the soils are low to medium in available nitrogen content. Soil nitrogen content is an important environmental factor that affects the rate of nutrient uptake by plants. The present study showed low to medium concentration of available nitrogen in all the samples. Similar results were also revealed by Kire (1992) [13], Ravikumar *et al*. (2007) [23], Olabode and Oriola (2013) [21], Shivanna and Nagendrappa (2014) [30], Jayanthi *et al*. (2015) [11], Namei *et al*. (2016) [18].

Available Phosphorus

The data presented (Table2) average available phosphorus in the two cropping system of rice viz., Dry direct seeded and Wet Transplanted. Majority of the samples in Dry direct seeded showed medium ranged available phosphorus with highest 31.3 kg ha^{-1} by Nsunyu village and the lowest by Tsonsa 19.8 kg ha^{-1}. Under transplanted system the highest value of 29.3 kg ha^{-1} by Kohima village and lowest value of 18.5 kg ha^{-1} were revealed. The effect of Jhum cultivation on available Pare the increases in the soil solution concentrations and leaching of mineral forms of P (Murphy *et al*. 2006) [17]. Increasing temperature caused an increase in available P because of the mineralization of OM (Giovannini *et al*. 1990) [9]. The increase in available P at burning sites could be due to the presence of ash which is rich in P (Ogundele *et al*. 2011) [20]. Similarly, Tekaling and Haque (1987) [36] reported that soil OM as the main source of available P. Similar results have been reported by Ravikumar *et al*. (2007) [23], Jayanthi *et al*. (2015) [11].

Available Potassium

The average value of available potassium in both dry direct seeded and transplanted system fall under high range (Table 3). Under dry direct seed, the highest 520.4 kg ha^{-1} by Nsunyu village and the lowest 381.7 kg ha^{-1} by Tsonsa village with mean value of 451.3 kg ha^{-1}, whereas under Transplanted system the available potassium was lower than dry direct seeded system. Highest 485.3 kg ha^{-1} by Kohima village and lowest 279.6 kg ha^{-1} with mean value of 370.4 kg ha^{-1} was reported. Similar findings have also been reported by Amenla *et al*. (2010) [1], for the soils of Nagaland. Kumar and Rao.

(1990) [14], Meena *et al*. (2006) [16], Ravikumar *et al*. (2007) [23], Baruah *et al.* (2014) [2], Jayanthi *et al*. (2015) [11], Tadesse (2016) [35] also reported high status of available potassium. Sharma (2004) reported that the exchangeable K is the most important chemical pool contributing to the nutrition of rice and wheat grown in sequence.

Available Sulphur

The data on available sulphur are presented in table3 on the basis of dry direct seeded and transplanted system varied from 23.3 to 32.76 kg ha^{-1} and 10.42 to 21.42 kg ha^{-1} with mean value 27.72 and 16.18 kg ha^{-1}, respectively. The dry direct seeded rice fields showed higher value than transplanted rice fields. Under dry direct seeded the highest 32.76 kg ha^{-1} and lowest 23.29 kg ha^{-1} revealed by Tsonsa and Likhwenchu village, respectively whereas in transplanted rice field, the highest 21.42 kg ha^{-1} and lowest 10.42 kg ha^{-1} revealed by Kigwema and Kohima village, respectively. Similar results have been reported by William C.H. *et al*. (1964) [38], Singh *et al*. (2000) [33] Singh *et al*. (2006) [32], Ravikumar *et al*. (2007) [23], Namei *et al*. (2016) [18].

Conclusion

From the findings of the present investigation, it can be concluded that the soils of the study area differ in soil fertility status according to type of land use system. Soils are rich in organic matter, low to medium in nitrogen, phosphorus and Sulphur. Soils of study area were high in available potassium. The soils have major problem of acidity.Results indicated that there is high scope of improving the soil fertility status and productivity, lime addition is essential along with proper nutrient management of NPK. Jhum cycle should be increased to keep the soil living. In transplanted fields, irrigation schedule should be maintained to avoid flooding and reduce loss of nutrients by leaching.

Table 1: Soil pH, EC & SOC as influenced by land use system under different village of Kohima district.

Village	Land use system	pH		EC (dSm^{-1})		SOC (%)	
		Range	Average	Range	Average	Range	Average
Chunlika	Dry direct seeded	4.9-5.0	4.94	0.07-.14	0.12	1.9-2.1	2.02
Likhwenchu	Dry direct seeded	5.0-5.2	5.10	0.05-.09	0.07	1.0-2.5	1.82
Nsunyu	Dry direct seeded	4.9-5.3	5.06	0.04-.09	0.06	1.7-2.4	2.00
Rusoma	Dry direct seeded	5.0-5.3	5.14	0.07-.13	0.08	0.9-2.5	1.84
Tsonsa	Dry direct seeded	5.0-5.1	5.06	0.04-.06	0.05	1.8-2.0	1.90
	Mean		**5.06**		**0.076**		**1.92**
Jakhama	Transplanted	5.1-5-5	5.26	0.03-.07	0.05	1.0-1.8	1.38
Jotsoma	Transplanted	5.3-5.6	5.46	0.04-.18	0.09	0.6-1.0	0.80
Kigwema	Transplanted	5.4-5.8	5.54	0.04-.08	0.06	1.2-1.7	1.38
Kohima	Transplanted	5.5-5.7	5.58	0.04-.27	0.15	0.9-1.8	1.54
Zubza	Transplanted	4.9-5.5	5.22	0.03-.04	0.04	0.8-1.5	1.12
	Mean		**5.41**		**0.078**		**1.24**

Table 2: N & P as influenced by land use system under different village of Kohima district.

Village	Land use system	N (kg ha^{-1})		P (kg ha^{-1})	
		Range	Average	Range	Average
Chunlika	Dry direct seeded	175.6-238.3	205.7	12.8 - 41.0	29.5
Likhwenchu	Dry direct seeded	238.3-326.4	268.3	18.0 - 48.7	30.3
Nsunyu	Dry direct seeded	263.4-326.1	291.0	23.1 - 33.3	31.3
Rusoma	Dry direct seeded	188.1-275.9	238.3	7.01 - 48.7	31.2
Tsonsa	Dry direct seeded	250.8-326.1	298.5	7. 7 - 26.9	19.8
	Mean	**Mean**	**260.3**		**28.4**
Jakhama	Transplanted	188.1-263.4	240.8	15.4 - 35.9	22.4
Jotsoma	Transplanted	200.7-288.5	240.8	12.8 - 25.6	18.5
Kigwema	Transplanted	263.4-288.5	278.4	7.7 - 35.9	22.6
Kohima	Transplanted	112.8-313.6	225.7	20.5 - 33.4	29.3
Zubza	Transplanted	175.6-238.3	205.7	19.2 - 30.8	23.6
	Mean	**Mean**	**238.3**		**23.3**

Table 3: K & S as influenced by land use system under different village of Kohima district.

Village	Land use system	K (kg ha^{-1})		S (kg ha^{-1})	
		Range	Average	Range	Average
Chunlika	Dry direct seeded	403.1 - 564.5	458.3	17.5 - 35.7	24.5
Likhwenchu	Dry direct seeded	295.7 - 545.1	453.1	6.6 - 29.4	23.3
Nsunyu	Dry direct seeded	430.1 - 564.5	520.4	9.8 - 38.4	27.2
Rusoma	Dry direct seeded	268.8 - 518.2	443.0	27.3 - 33.6	30.9
Tsonsa	Dry direct seeded	161.3 - 483.8	381.7	27.3 - 35.7	32.8
	Mean		**451.3**		**27.7**
Jakhama	Transplanted	188.2 - 483.8	348.6	9.8 - 27.3	18.4
Jotsoma	Transplanted	188.2 - 457.0	279.6	5.6 - 29.4	19.0
Kigwema	Transplanted	268.8 - 518.2	432.2	11.2 - 33.6	21.4
Kohima	Transplanted	349.4 - 591.4	485.3	4.9 - 18.9	10.4
Zubza	Transplanted	161.3 - 564.5	306.4	9.1 - 17.5	11.6
	Mean		**370.4**		**16.2**

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