www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(8): 1210-1215

www.thepharmajournal.com
Received: 01-05-2022
Accepted: 05-06-2022

Pramod Kumar
Department of Agrometeorology and Environmental Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Ramesh Kumar
Department of Agrometeorology and Environmental Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Pragyan Kumari
Department of Agrometeorology and Environmental Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Asisan Minz
Department of Soil Science and Agriculture Chemistry, BAU, Ranchi, Jharkhand, India

Raj Kiran Hansdah
Department of Agrometeorology and Environmental Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Kuldeep Kumar
Department of Agronomy, BAU, Ranchi, Jharkhand, India

Corresponding Author
Pramod Kumar
Department of Agrometeorology and Environmental Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Effect of different agro-ecosystems on physico-chemical properties of soil in response to changing pattern of rainfall in Chota Nagpur plateau of Giridih district of Jharkhand

Pramod Kumar, Ramesh Kumar, Pragyan Kumari, Asisan Minz, Raj Kiran Hansdah and Kuldeep Kumar

Abstract
Present study has been formulated a plans with a view to characterize physico-chemical properties of soil under three different agro-ecosystems (upland, midland and lowland) soils in Giridih district of Jharkhand. The total thirteen representative blocks were selected for soil sample collection. Hence, altogether 39 soil samples were collected for determining soil physical and chemical properties by standard protocol. Results revealed that under three different agro-ecosystems, soil of lowland, midland and upland were differs significantly in physico-chemical properties. Soil texture was recorded to be sandy loam texture (69.6 to 81.0 sand percent) for upland to sandy clay loam to loamy (60.8 to 65.0%) in medium land. The lowland soil had low bulk density as compared to upland and midland soil which, varies from 1.3 to 1.8 Mg/m^{-3}. Highest field capacity (31.0%), PWP (18.7%) and available water (12.3%), while, lowest value for FC (15.0%), available water (6.4%) and PWP (8.6%) were observed in lowland soil of Jharkhand. The soil pH varied from near neutral pH to slightly acidic in nature under lowland to upland soil. Under lowland, midland and upland soil the lowest organic carbon content 3.2 g/Kg^{-1}, 2.6 g/Kg^{-1} and 2.1g/Kg^{-1}, while, the highest value was 8.4 g/Kg^{-1}, 6.8 g/Kg^{-1} and 6.7 g/Kg^{-1} was recorded respectively. Highest value of available N (465 Kg/ha^{-1}) and available K (272.2 Kg/ha^{-1}) was observed from lowland, but the higher value of phosphorous (193.4 Kg/ha^{-1}) was observed from the upland soils of Giridih districts of Jharkhand.

Keywords: Soil, upland, lowland, midland, topo-sequence

Introduction
Rainfall is one of the most important factor for rainfed agriculture in India. About 61% of farmers in India rely on rainfed agriculture (NRAA, 2019). Around 58% of cultivated area is under rainfed condition which contributes to 40% of food productions in country (Prasad *et al*., 2015) [20]. Due to dependency on monsoon, the productivity of the rainfed area is very low. The seasonal and annual rainfall received and its variability directly influences the success or failure of crops through its beneficial or adverse effect on growth and yield (Halikatti *et al*., 2010) [12]. Therefore the analysis of annual and seasonal distribution of rainfall is essential for selection of suitable crops and varieties for better production. The variability analysis of rainfall found to be useful in taking cropping pattern decisions (Prabhakar *et al*., 2017) [19].
Probability analysis of rainfall data enables us to determine the expected rainfall at various chances (Bhakar *et al*., 2008) [1]. It is needed to know the rainfall behaviour for water resources management and crop planning (Sachan *et al*., 2016) [22]. The lesser amount of rainfall at different probability levels is computed by fitting gamma distribution probability model on weekly basis (Biswas and Khambete, 1989) [3].
Analysis of long term weather data in combination with soil characteristics helps to develop and modify the crops and varieties, management practices in order to achieve optimum crop yields and sustainable crop production. The information on the length of dry spells can be used for deciding a particular crop or variety (Mathlouthi and Lebdi, 2008; Admasu *et al*., 2014) [17]. It is essential to plan the crops by utilizing best use of rainfall potential of an area.
Crop planning is a critical part of farming. A crop plan developed before the season helps the farming community in selection of crops and their varieties for different lands under the abnormal rainfall situations. Knowledge of the rainfall and soil properties helps in better planning of crops mainly during drought years under different land situations (i.e. upland,

medium land and lowland). Crop planning also provides the sowing window of crop in growing season and successive crops in next season.

Giridih district of Jharkhand comes under Central and Lower Plateau Zone and Hill Region and Agro-climatic sub zone IV having total geographical area of 4962 sq. km is more or less rainfed. Giridih is dominated by hills, valleys and plateau with a considerable area (32.12%) under forest. The soils occurring in different land situations have been characterised during soil resource mapping of the state on 1:250,000 scale (Haldar *et al*., 1996) [11] and three soil orders namely Alfisols, Inceptisols and Entisols were observed in Giridih district. Alfisols were the dominant soils covering 63.6 percent of TGA followed by Inceptisols (18.4%) and Entisols (16.9%). Major cereal crops in the district are Paddy, Maize, pulses (black Gram, Arhar, Pea, Moong, Urad) and vegetable crops (Tomato, Brinjal, Potato, Onion, Radish, Ridged Gourd, Cabbage, Bottle Gourd, Bitter Gourd, Okra, Cauliflowers etc). The soils of experimental area's are classified under the upland soils as Udic Haplustalfs and lowland as Typic Haplustalfs. The lowland soils were gray coloured, clay in texture, low in organic carbon and alkaline in reaction. Whereas the upland soils were characterized as yellow in colour, loamy sand to sandy loam in texture, low in organic matter and slightly acidic to neutral in reaction (Singh *et al*., 2000) [25].

The soil physico-chemical properties like depth, texture, bulk density, aggregation, cation exchange capacity are directly depends on the amount of water stored in the soil profile Singh *et al*., (2005) [24], above mentioned parameters are basically related to the pattern of rainfall.

Continuous intensive cropping without addition of organics substrates under variability of rainfall pattern has led hamper the physico-chemical properties of soils which indicates gradual losses in soil quality that causes drastic reduction in yield.

It can be managed by close monitoring of seasonal conditions, suggesting contingent crops on real time basis, adopting different farm level options like change in sowing dates, adopting suitable crops/varieties and supplemental irrigation using micro irrigation coupled with advance weather information. These measures have shown to reduce the adverse impacts of changing climate.

Present study has been formulated a plans with a view to identify more accurate crops and their verities for different climatic situations especially under response of low rainfall, in Giridih district of Jharkhand with objective "Effect of different agro-ecosystems on physico-chemical properties of soil in response to changing pattern of rainfall in Chota Nagpur plateau of Giridih district of Jharkhand".

Materials and Method

Area description of the study area

The Giridih district fall under agro-climatic sub zone IV which lies in the North - Eastern part of the state Jharkhand and having a total geographical area of 4962 km^2 and is situated at Longitude: 85°40′30" to 86°34′18" E and Latitude: 23°52′ 59"to 24°46′47" N, under rainfed area. The farmers of state Jharkhand (Giridih) is mostly adopted mono-cropping system due to uncertain rainfall pattern. The soils of experimental field are generally categories under laterite and sandy in nature. Out of total geographical area, the net sown area is 138.4 ('000 ha) with rice and maize as main agricultural crops. The district receives an average annual rainfall of 1058.4 mm. and most of the rainfall (84.6) occurs during the rainy season. The mean annual temperature remains at about 26 °C. The average temperature during winter season remains at 10 °C and the highest annual temperature reaches upto 45 °C.

Collection of soil samples and analysis

Soil samples from 0-15 cm depth were taken from upland, midland and lowland from each blocks (Giridih, Bengabad, Gandey, Jamua, Birni, Dhanwar, Deori, Tisari, Gawan, Pirtand, Dumari, Bagodar and Suriya) of Giridih district for determination of most important physical (texture, bulk density, field capacity, permanent wilting point, available water capacity etc) and chemical (pH, organic carbon, avail. N, P and K) parameters by standard protocols in the laboratory of Department of Agro-meteorology and Environmental Science, Birsa Agricultural University, Kanke, Ranchi. Hence, altogether 39 soil samples were collected. Separate undisturbed soil samples were collected in cores for determination of Bulk density of soil. Representative soil samples were collected in such a way that the composite soil sample uniformly represents the soil characteristics of the selected blocks. The geo-positions of each soil sampling sites were taken with the help of GPS (Google-Map) and the locations of each (site have been given in Table 1.)

Table 1: Geo-positions of the sampling sites under blocks of Giridih

Name of station	Latitude (°N)	Longitude (°E)	Altitude (meter)
Giridih	24°11'05"	86°18'08"	289 m
Bengabad	24°18'06"	86°21'39"	298 m
Gandsey	24°10'58"	86° 26'11"	298 m
Jamua	24°22'13"	86° 08'51"	298 m
Birni	24° 19'38"	85° 50'04"	607 m
Dhanwar	24°25'12"	85° 58'48"	336 m
Deori	24°30'36"	86°11'33"	298 m
Tisari	24°34'10"	86°03'32"	298 m
Gawan	24°37'06"	85°56'51"	346 m
Pirtand	24°02'36"	86°09'37"	332 m
Dumari	23°59'29"	86°00'15"	332 m
Bagodar	24°04'59"	85°51'59"	356 m
Suriya	24°10'51"	85°53'30"	308 m

Separate undisturbed soil core were collected for determining bulk density of soils. Soil texture was determined by hydrometer as described by Bouyoucos, 1927. The USDA textural triangle was used for determination of textural class of the soils. Field capacity and permanent wilting point were determined by Pressure plate apparatus (Richard, 1949). Soil moisture held between 0.033 and 1.5 M Pa was considered to be available moisture in the soil (Peterson *et al*., 1971). Soil pH was determined in soil-water suspension of 1: 2.5 (w/v), using glass electrode by digital pH meter (ELICO 1614) (Jackson, 1973) [13]. Organic carbon of the soil was estimated by chromic acidwet digestion method as outlined by Walkley and Black (1934) [29]. Available nitrogen was estimated by distillation of soil with alkaline potassium permanganate as per method suggested by Subbiah and Asija (1956) [26]. Available phosphorus was extracted with Bray-P1 extractant (0.03 NH4F in 0.025 HCL solutions) (Bray and Krutz 1945) and was determined as described by Jackson (1973) [13] by double beam digital spectrophotometer (SPECTRA SCAN UV 2600). Available K was determined by Flame photometer after extraction of soil with 1N NH4OAc (pH 7.0) soil and solution ratio was maintained at 1.5 (w/v) as described by

Jackson (1973) [13].

Statistical analysis

Analysis of variance (ANOVA) was done at 95% confidence level for comparing difference in the mean of soil physical and chemical parameters of upland, midland and lowland soil.

Result and Discussion

Soil physical properties

There was a significant difference was noted in physical and chemical properties of upland, midland and lowland agricultural field (Table 2).

This Table 2, remarkably showed that the soil texture of experimental field, there was sand content are decreased from upland to lowland, *i.e*., ranged from 46.0 – 81.0 5%, while, the content of silt and clay were significantly increasing from upland to lowland, which were varied from 8.2 – 25.0% and 10.6 – 29.0% respectively. Soil texture was recorded to besandy loam texture (because experimental soil contains at least 69.6 to 81.0 sand percent) for upland, soil in all the blocks of the district. Similarly, in case of medium land soil texture was varied from Sandy Clay Loam to Loamy in textural class with sand content (60.8 to 65.0%). Highest sand percent 65% and lowest 60.8% was reported for medium land situation.

The finding revealed thatthe experimental soil was medium in texture (Sandy Clay Loam to Sandy Loam) in lowlands. This wide textural variation might be due to variation in parent material (granite-gnesis to alluvium), topography, in-situ weathering and translocation of clay. Similar results were also found by Kumar *et al*., (2012) [16], Gupta *et al*., (2019) [9] and Gupta *et al*., (2020) [10] under the different agro-climatic zone of Jharkhand. There are also several scientist reported that the content of silt showed an irregular trend with depth and this irregular distribution of silt might be due to variation in weathering of parent material or in-situ formation of soil (Devi *et al*., 2015) [8].

As per finding (Table 2), revealed that the lowland soil had low bulk density as compared to upland and midland soil. The bulk density of experimental soil's were varied from 1.3 to 1.8 Mg/m^{-3}. The value of bulk densities varied from 1.7 to 1.8 Mg/m^{-3}, 1.6 to 1.7 Mg/m^{-3} and 1.3 to 1.4 Mg/m^{-3} for upland, medium land and lowland soil, respectively. Following the value of mechanical separates and textural class, the lowest value 1.7 Mg/m^{-3} were reported under upland soil, while in case of medium land 1.6 Mg/m^{-3} was observed 1.7 Mg/m^{-3}. Similarly under lowland the lowest value was reported 1.3 Mg/m^{-3}. Higher bulk density of a soil, is an indicator of low soil porosity and soil's become highly compacted. The more or less an increasing trend of bulk density were varies with depth due to low organic matter and less aggregation formation. Vedadri *et al*., (2018) [27] showed that the low bulk density in surface soils was due to higher organic matter content and this variation in BD is due to lowest clay content Brar, (1991) [5].

Result showed that as we proceeds from upland to lowland the value of field capacity (FC), permanent wilting point (PWP) and the content of available water were increased, means the lowest value of FC, PWP, Available water were reported in upland soil as compared to midland and lowland soil. The variability in values ranged from 15.0 - 31.0%, 8.6 - 18.7% and 6.4 -12.3% for field capacity, PWP and available water, respectively, of the study area. Results showed that the performance of upland soil was poor than rest of the agro-ecosystems (midland and lowland) soil. Highest field capacity (31.0%), PWP (18.7%) and available water (12.3%), while, lowest value for FC (15.0%), available water (6.4%) and PWP (8.6%) were observed in lowland soil of Jharkhand. Experimental soil retained highest soil moisture at field capacity (18.9% in uplands, 24.4% in medium lands soil and 31.0% in lowlands soil. Similarly, Permanent wilting point was recorded highest in upland soil (10.3%), in medium land (14.3%) and low lands soil (18.7%) (Table 2).

Generally, lowland soil retained more available water than the medium land and upland soils of Jharkhand. The irregular trend of FC, PWP and available water of soil with different depth were due to the illuviation and eluviation of finer fractions in different horizons (Vedadri *et al*., 2018) [27]. Similar results on above mentioned parameters with respect to topography and texture have been also reported by Choudhery and Somawanshi (2000) [7] and Verma *et al*., *(*2001) [28].

Table 2: Physical properties of soil of Giridih district

Blocks	Land situation	Soil Separates (%)			Textural class	BD (Mgm^{-3})	FC (%)	PWP (%)	Avail. Water (%)
		Sand	Silt	Clay					
Giridih	Upland	71.6	15.6	12.8	SL	1.7	17.6	9.2	8.4
	Midland	64.1	17.6	18.3	SL	1.7	22.2	12.6	9.6
	Lowland	52.8	22.5	24.8	SCL	1.4	27.9	16.5	11.4
Bengabad	Upland	74.8	14.6	10.6	SL	1.8	16.2	8.6	7.6
	Midland	64.0	20.6	15.4	SL	1.6	20.7	10.9	9.8
	Lowland	55.6	22.8	21.6	SCL	1.4	25.8	14.9	10.9
Gandey	Upland	69.6	18.8	13.6	SL	1.8	18.9	10.3	8.6
	Midland	64.6	19.8	15.6	SL	1.6	21.0	11.5	9.5
	Lowland	53.6	21.8	24.6	SCL	1.4	27.7	16.5	11.2
Jamua	Upland	72.5	15.4	12.2	SL	1.7	17.4	9.2	8.2
	Midland	61.6	19.6	18.8	SL	1.6	23.1	13.2	9.9
	Lowland	57.6	20.6	21.8	SCL	1.3	25.5	14.9	10.6
Birni	Upland	80.0	8.7	11.3	LS	1.8	15.2	8.6	6.6
	Midland	62.8	16.6	20.6	SCL	1.6	24.0	14.3	9.7
	Lowland	55.0	21.6	23.4	SCL	1.3	26.5	15.4	11.1
Dhanwar	Upland	74.8	13.0	12.2	SL	1.7	16.8	9.2	7.6
	Midland	64.0	19.8	16.2	SL	1.6	21.2	11.5	9.7
	Lowland	52.8	21.4	25.8	SCL	1.4	28.4	17.1	11.3
Deori	Upland	74.8	14.4	10.8	SL	1.8	16.2	8.6	7.6
	Midland	63.0	19.8	17.2	SL	1.6	21.9	12.1	9.8

	Lowland	55.0	20.8	24.2	SCL	1.4	27.0	16.0	11.0
Tisari	Upland	81.0	8.2	10.8	LS	1.8	15.0	8.6	6.4
	Midland	60.8	18.6	20.6	SCL	1.6	24.4	14.3	10.1
	Lowland	53.0	23.8	23.2	SCL	1.4	26.9	15.4	11.5
Gawan	Upland	73.0	15.6	11.4	SL	1.7	16.7	8.6	8.1
	Midland	64.0	16.6	19.4	SL	1.6	22.8	13.2	9.6
	Lowland	53.0	22.8	24.2	SCL	1.4	27.4	16.0	11.4
Pirtand	Upland	80.8	8.6	10.6	LS	1.8	15.0	8.6	6.4
	Midland	65.0	16.6	18.4	SL	1.6	22.0	12.6	9.4
	Lowland	58.8	20.5	20.7	SCL	1.3	24.8	14.3	10.5
Dumari	Upland	70.8	18.4	10.8	SL	1.8	17.1	8.6	8.5
	Midland	65.0	16.8	18.2	SL	1.6	22.0	12.6	9.4
	Lowland	60.2	15.8	24.0	SCL	1.3	26.2	16.0	10.2
Bagodar	Upland	70.8	17.4	11.8	SL	1.8	17.6	9.2	8.4
	Midland	63.4	19.2	17.4	SL	1.7	21.9	12.1	9.8
	Lowland	46.0	25.0	29.0	CL	1.4	31.0	18.7	12.3
Suriya	Upland	71.0	15.8	13.2	SL	1.7	18.2	9.8	8.4
	Midland	63.0	17.8	19.2	SL	1.6	23.0	13.2	9.8
	Lowland	54.1	21.7	24.2	SCL	1.3	27.2	16.0	11.2

Soil chemical properties

Table 3, clearly revealed that the soil pH varied from near neutral pH to slightly acidic in nature under lowland to upland soil. The value of soil pH for lowland soil was ranged from 4.8 - 8.2 while it was 4.7 – 7.8 and 4.5 – 7.4 for midland and upland soil, respectively. Under lowland, midlands and upland the lowest pH value 4.8, 4.7 and 4.5, while the highest pH 8.2, 7.8 and 7.4 was observed, respectively. The higher soil pH was reported on medium and lowland soil this might be probably due to accumulation of soluble bases through runoff water in soil from upper elevation to lower elevation. Higher soil pH in lowland soil as compared to upland soil has also been reported by Kumar *et al*., (2012) [16] and Gupta *et al*., (2019) [9] in Giridih districts of Jharkhand.

Experimental soil of Giridih districts of Jharkhand clearly showed that the study area were low to high content in organic carbon. The most of the experimental field were in the medium to high range of organic carbon (3.0 – 8.4 g/Kg^{-1}) content. Under lowland, midland and upland soil the lowest organic carbon content 3.2 g/Kg^{-1}, 2.6 g/Kg^{-1} and 2.1g/Kg^{-1}, while, the highest value was 8.4 g/Kg^{-1}, 6.8 g/Kg^{-1} and 6.7 g/Kg^{-1} was recorded respectively (Table 3). The maximum organic carbon in lowland might be due to lower rate of decomposition of organic matter in lowlands which remained water saturated during major part of a year (Sen Gupta *et al*., 2019) [23]. This means the soil of experimental blocks are poor in organic carbon content that results the lower fertility status and need a proper integrated nutrients management practices to achieved sustainability for a longer period with high crop production.

Results revealed that as compared to three agro-ecosystems lowland soil had significantly higher soil available nitrogen and potassium content. Soil of the Giridih districts of Jharkhand has been classified under low to medium in available nitrogen (130 to 465 Kg/ha^{-1}), low to high in available P (11.8 to 193.4 Kg/ha^{-1}) and available K content was reported low to medium in ranged from (50.4 to 272.2 Kg/ha^{-1}). Highest value of available N and available K were observed in lowland soil, where as high available P was mainly observed in upland soil of studied soil. Highest value of available N (465 Kg/ha^{-1}) and available K (272.2 Kg/ha^{-1}) was observed from lowland, but the higher value of phosphorous (193.4 Kg/ha^{-1}) was observed from the upland soils of Giridih districts of Jharkhand. Similarly, the lowest content of available N, P and K was noted as 130 Kg/ha^{-1}, 11.8 Kg/ha^{-1} and 50.4 Kg/ha$^{-1,}$ respectively, in Giridih district of Jharkhand. The average phosphorus availability increased more than two to three times in respect to upland soils as compared to lowlands soil.

Combining the status of three major plant nutrients (*i.e.* N, P and K) in soil of Giridih district, it is clear that majority of soil were under low to medium range, except available P, means we can harvest a good crop yield only by adopting Soil Test Based Nutrient Management practices. Similar results on soil available nutrient status have been also reported by several researchers, Sengupta *et al*., (2019) [23], Bhardwaj *et al*., (1994) [2].

Table 3: Important chemical properties of soil Giridih district

Blocks	Land situation	pH	Org. Carbon g/Kg^{-1}	Av. N (Kg/ha^{-1})	Av. P (Kg/ha^{-1})	Av. K (Kg/ha^{-1})
Giridih	Upland	5.5	3.0	195	91.0	90.7
	Midland	6.3	3.8	235	25.2	94.1
	Lowland	7.0	4.2	255	28.6	194.9
Bengabad	Upland	5.3	3.3	210	152.3	50.4
	Midland	6.0	3.5	220	16.0	65.0
	Lowland	6.3	5.7	330	13.4	80.6
Gandey	Upland	5.4	2.3	140	125.1	50.4
	Midland	5.5	5.5	320	31.1	56.0
	Lowland	5.8	5.8	335	30.2	56.0
Jamua	Upland	6.0	2.5	170	36.1	67.2
	Midland	6.8	2.6	175	17.1	73.9
	Lowland	7.2	3.2	205	14.6	95.2
Birni	Upland	5.9	2.1	130	20.2	59.4

	Midland	6.8	3.2	205	14.3	63.8
	Lowland	7.2	4.3	260	11.8	125.4
Dhanwar	Upland	5.2	3.9	240	19.9	68.3
	Midland	6.4	5.1	300	17.9	108.6
	Lowland	6.9	5.5	320	12.9	146.7
Deori	Upland	6.2	3.3	210	121.8	69.4
	Midland	6.8	4.5	270	37.0	103.0
	Lowland	7.0	4.5	275	16.8	147.8
Tisari	Upland	5.7	3.6	225	24.4	60.5
	Midland	6.5	4.6	275	22.1	60.5
	Lowland	6.8	5.5	320	18.8	108.6
Gawan	Upland	7.4	3.3	210	44.5	105.3
	Midland	7.8	3.5	220	30.0	121.0
	Lowland	8.2	4.9	290	18.8	244.2
Pirtand	Upland	6.7	2.5	170	153.7	78.4
	Midland	7.4	3.2	205	95.2	189.3
	Lowland	8.1	4.5	270	14.6	191.5
Dumari	Upland	4.5	4.8	285	24.6	50.4
	Midland	4.7	6.1	350	20.2	51.5
	Lowland	4.8	6.8	385	17.1	85.1
Bagodar	Upland	4.9	6.7	380	76.7	61.6
	Midland	7.2	6.8	385	51.0	79.5
	Lowland	7.4	8.4	465	26.9	272.2
Suriya	Upland	4.9	3.2	205	193.4	56.0
	Midland	6.0	3.9	240	58.0	221.8
	Lowland	7.1	8.3	460	54.3	255.4

Conclusion

This findings have reflected that soil physico-chemical properties of the experimental area were not in good status. Results revealed that under three different agro-ecosystems, soil of lowland, midland and upland were differs significantly in physico-chemical properties. The experimental lands are situated on different topo-sequence that measures different strategies and adoptions for the better crop production and agronomic practices in respect to water conservation especially in upland soil. The concentrations of soil pH, organic carbon contents and available N and K were found to be low to high from upland to lowland while available K was found highest in upland soil. Means, upland soil has lower soil pH, N and K content therefore upland soil needs suitable soil and water management strategies for enhancing crop production and better soil health management. To enhance the soil pH and fertility status of the experimental soil for a long term requires application of liming and balanced fertilization respectively.

References

1. Bhakar SR, Iqbal M, Devanda Mukesh, Chhajed Neeraj, Bansal AK. Probability analysis of rainfall at Kota. Indian J Agril. Res. 2008;42:201-206.
2. Bharadwaj V, Omanwar PK. Long term effects of continuously rotational cropping and fertilization on crop yields and soil properties. II Effects on EC, pH Organic matter and available nutrients of soil. J Ind. Soc. Soil Sci. 1994;42(3):387-392.
3. Biswas BC, Khambeta NK. Distribution of short period rainfall over dry farming tract of Maharashtra. Journal of Maharashtra Agricultural University, 1989.
4. Bouyoucos GJ. The hydrometer as new method for mechanical analysis of soils. Soil Sci. 1927;23:343-353.
5. Brar SPS. Bulk density as an index of soil texture. J Ind. Soc. Soil Sci. 1991;39:557-559.
6. Bray RH, Kurtz LJ. Determination of total, organic and available form of Phosphorus in soils. Soil Science. 1945;59:39-45.
7. Chaudhary SK, Somawanshi RB. Water retention characteristics of clay, loam and silty loam as influenced by irrigation water quality. J Ind. Soc. Soil Sci. 2000;48(3):593-595.
8. Devi PAV, Naidu MVS, Ramakrishna Rao A. Characterization and classification of sugarcane growing soils in southern agro-climatic zone: A case study in eastern mandals of Chittoor district in Andhra Pradesh. Journal of the Indian Society of Soil Science. 2015;63:245-258.
9. Gupta CK, Kumar R, Gupta DK. Physical and chemical properties of soil in upland and lowland agro-ecosystem of Garhwa district, Jharkhand. Environment and Ecology. 2019;37:393-397.
10. Gupta CK, Wadood A, Kumar R, Kumari P, Prasad SM. Effect of Topo-sequence on Physical and Chemical Soil Properties of Hazaribagh, Jharkhand. Journal of Agricultural Physics. 2020;20(1):82-86.
11. Haldar AK, Srivastava R, Thampi CJ, Sarkar D, Singh DS, Sehgal J, *et al*. Soils of Bihar for optimizing land use. NBSSPubl. 50b. (Soils of India Series), National Bureau of Soil Survey and Land Use Planning, Nagpur, India, pp. 70+4 sheets soil Map (1:500,000 scale), 1996.
12. Halikatti SI, Potdar MP, Hiremath SM, Dineshkumar SP. Annual and seasonal rainfall variability at Dharwad, Karnataka, Journal of Agrometerology. 2010;12(1):136-137.
13. Jackson ML. Soil Chemical analysis. Pretice hall of India Pvt. Ltd., New Delhi, 1973.
14. Kiran Hansdah R. Soil and Rainfall characterization of Saraikela-Kharsawan district for Crop Planning. (Unpublished) M.Sc. Ag. Thesis, BAU, Kanke, Ranchi, 2018.
15. Kumar B. Unpublished thesis, M. Sc. (Ag.)Thesis, B.A.U., Kanke, Jharkhand, 2013.
16. Kumar YSS, Naidu MVS. Characteristics and classification of soils represting major landforms in Vadamalapetamandal of Chittoor district, Andhra Pradesh. Journal of the Indian Society of Soil Science.

2012;60:376-383.
17. Mathlouthi M, Lebdi F. Characterization of dry spell events in a basin in the North of Tunisia. In. Proceedings of the First International Conference on Drought management: Scientific and technological innovations, 2008, 43-48.
18. Peterson GW, Cumingham RL, Matelski RP. Laboratory measurement of available soil water cited in comment and better to the editor. Soil Sci. Amer. Proc. 1971;35:852.
19. Prabhakar AK, Singh KK, Lohani AK, Chandniha SK. Long term rainfall variability assessment using modified Mann-Kendall test over Champua watershed, Odisha. Journal of Agrometeorology. 2017;19(3):288-289.
20. Prasad JVNS, Rao CS, Ravichandra K, Jyothi CN, Prasad Babu MBBV, Babu R, *et al*. Green house gas fluxes from rainfed sorghum (*Sorghum bicolor*) and pigeon pea (*Cajanus cajan*) – Interactive effects of rainfall and temperature, Journal of Agrometeorology. 2015;17(1):17-22.
21. Richard LA. Pressure membrance apparatus construction and use. Agro. Eng. 1949;28:451-454.
22. Sachan S. Probability analysis of rainfall and crop water requirement using CROPWAT model for crop planning in a canal command of upper Bhima Basin of Maharashtra. International Journal of Agriculture Environment and Biotechnology. 2016;9(1):123.
23. Sengupta T, Bandyopadhyay BK, Tripathi S. Changes in soil properties due to raising of elevation of lowland rice fields through land shaping in coastal saline soils of Sundarbans, West Bengal. International Journal of Chemical Studies. 2019;7(1):1257-1261.
24. Singh R, Kundu DK. Production of profile water storage capacity for major soil groups of Orrisa, India Journal of Soil Conservation. 2005;33:128-231.
25. Singh RN, Singh RNP, Diwakar DPS. Characterization of old alluvial soils of Sone basin. J Ind. Soc. Soil Sci. 2000;48(2):352-357.
26. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soil. Curr. Sci. 1956;25:259-260.
27. Vedadri U, Naidu MVS. Characterization, classification and Evaluation of soils in Semi-arid Ecosystem of Chillakur Mandal in SPSR Nellore District of Andhra Pradesh. Journal of the Indian Society of Soil Science. 2018;66(1):9-19.
28. Verma SK, Ranade DH, Mishra VK. Moisture release pattern and available water content in normal and sodic clay soil. J Ind. Soc. Soil Sci. 2001;49(1):21-24.
29. Walkley A, Black IA. An examination of the degtjareff method for determination soil organic matter and a proposed modification of chromic acid titration method. Soil Science. 1934;37:29-38.