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Assessment of Soil for Increasing the Yield of Mustard in Northern Hills, Chhattisgarh, India

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A B S T R A C T

A survey of chemical properties of soil of Pathalgaon and Bagicha Block of Jashpur District, Chhattisgarh India was carried out in year 2017-18. 27 Soil samples were collected at a depth of 0-15 from 3 Village- Kamarema, Gala, Kodkelkhajri. Soil sample were analyzed for pH, EC, OC and N, P, K, Zn and S. The value of pH, EC, OC is found in ranges from 5.42 to 6.51, 0.04- 0.16 dSm^{-1}, 0.44 to 0.63 per cent respectively. and N, P, K, S, Zn is found in ranges from 182.2 to 236.25 kg ha^{-1}, 9.40 to 16.6 kg ha^{-1}, 101.4 to170.3 kg ha^{-1}, 25.87 to 33.2 kg ha^{-1}, 1.70 to 4.74kg ha^{-1} respectively. The pH is acidic to neutral, Electrical Conductivity is Low to high. The status of organic carbon percent and nitrogen is low to medium, the status of phosphorus, potassium is Low to medium and sulphur is medium in soil, and Zn is high and Maximum yield 13.40 q ha^{-1} and minimum 8.20 q ha^{-1}. The maximum siliqua are often 110.02 an minimum no. of siliqua 70.09 based on soil test and their recommendation.

Introduction

Mustard occupies a prestigious place in Indian agriculture due to their vital role in the sustainable economy of the country. Vegetable oil (edible) plays a significant role in human nutrition. Indian mustard is one of the most important winter oil seed crops. Sulphur improves the quality of mustard by increasing the oil contents, protein content and several fatty acids. Sulphur helps in chlorophyll formation and also encourages vegetative growth. It also helps in the reduction-oxidation reactions in the respiration. The importance of micronutrients application in increasing crop production has been recognized in India (Dubey *et al.*, 2013). Soil is the basic resource for agriculture and its

proper management is essential to sustain agricultural production and maintain soil productivity. Soil testing is one of the best available tools, to ascertain the physical characteristics & nutrient status of a field. Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts, 1998).

The state receives annual rainfall ranging from less than 1200 mm to greater than 1600 mm in different areas. There are a number of types of soil found in Chhattisgarh area but there are four major types namely Kanhar, Matasi, Dorsa and Bhata.

The soils of the region are deficient in important mineral nutrients like nitrogen, phosphorous, lime and potash, which are concentrated in the lower parts of the soil layer (Tripathi and Bhardwaj, 2016). At present 27 districts are there in Chhattisgarh. Chhattisgarh is situated between 17-23.70 N latitude and 80.40-83.380 E longitude in Central eastern part of India. The total geographical area of the state is 136.03 thousand sq. km.

Geographically, Chhattisgarh is divided into three distinct land areas viz.

Chhattisgarh Plains

Bastar Plateau and

Northern Hill Zones

India is amongst the largest vegetable oil economic in the world. Mustard is rich in minerals like calcium, manganese, copper, iron, selenium, zinc, vitamin A, B, C and proteins. 100 g mustard seed contains 508 kcal energy, 28.09 g carbohydrates, 26.08 g proteins, 36.24 g total fat and 12.2 g dietary fibre. Sulphur plays a significant role in increasing production especially in oilseeds (Upadhyay *et al.,* 2016).

Materials and Methods

Pathalgaon and Bagicha is a Block located in Jashpur district Placed in rural region of Chhattisgarh, it is one among the blocks of Jashpur District. Pathlgaon is located at 22°30'378" N *latitude*83°29'154" E longitute) normal rainfall is 1450.0 mm (2017-2018) and average annual rainfall 1726.0 mm. The region generally experiences hot, sub humid climate. It has an average elevation of 348 m (1,142 ft).

Sampling and analysis

The 27 soil samples were collected with0-15 cm. depths from 3 Village- Kamarema, Gala, Kodkelkhajri.

The pH, Ec, OC, N, P, K, S, Zn was determined by Mrida pariksahak Equipment, Developed by ICAR-Indian Institute of Soil Science, Bhopal.

Results and Discussion

Soil pH

The Lowest value of pH found in Kamarema at depth (0-15 cm) 5.42 and highest value in Kodkelkhajri at depth (0-15 cm) 6.51 and pH was found to be significant at different villages (Fig. 1, Table 1 and 2).

Electrical conductivity (EC)

The lowest value of electrical conductivity found in Kamarema at depth (0-15 cm) 0.04 dSm^{-1} and highest value in Kodkelkhajri at depth (0-15cm) 0.16 dSm^{-1} (Fig. 2). The EC was found to be significant at different villages.

Organic carbon (OC) percent

The lowest value of organic carbon percent is found in soil of Kamarema at depth (0-15 cm) 0.44 per cent and highest value in soil of Kodkelkhajri at depth (0-15cm) 0.63 per cent.

The OC (%) was found to be significant at different villages (Fig. 3).

Available nitrogen (kg ha^{-1})

The Lowest value of nitrogen is found in soil of Kamarema at depth (0-15 cm) 182.2 kg ha^{-1} and highest value in soil of Kodkelkhajriat depth (0-15cm) 236.25 kg ha^{-1}. The available nitrogen (kg ha^{-1}) was found to be significant at different villages (Fig. 4).

Available phosphorus (kg ha^{-1})

The value of available phosphorus (kg ha^{-1}) is found in varied from 10.4 to 20.2 kg ha^{-1}. The lowest value of phosphorus is found in soil of Kodkelkhajriat depth (0-15 cm) 9.40 kg ha^{-1} and highest value in soil of Kamarema at depth (0-15cm) 16.6 kg ha^{-1}. The available phosphorus (kg ha^{-1}) was found to be significant at different villages (Fig. 5).

Available potassium (kg ha^{-1})

The lowest value of potassium is found in soil of Kodkelkhajri at depth (0-15 cm) 101.4 kg ha^{-1} and highest value in soil of Kamarema at depth (0-15cm) 170.3 kg ha^{-1}. The available potassium (kg ha^{-1}) was found to be significant at different villages (Fig. 6).

Available sulphur (kg ha^{-1})

The lowest value of sulphur is found in soil of Kodkelkhajri at depth (0-15 cm) 25.87kg ha^{-1} and highest value in soil of Kamarema at depth (0-15cm) 33.2kg ha^{-1}. The available sulphur (kg ha^{-1}) was found to be significant at different depths and villages (Fig. 7).

Table.1 Rating chart for soil test values and their nutrient indices based on the specific rating chart modified from Brajendra *et al.*, (2014)

Soil property	Unit	Range		
Soil pH	pH unit	< 6.5 (Acidic)	6.5-7.5(Neutral)	>8.0 (Alkaline)
Electrical conductivity	dSm^{-1}	<1.0 (Normal)	1.0-2.0 (Critical)	>2.0 (Injurious)
Organic carbon	Percent	<0.5 (Low)	0.5-0.75(Medium)	>0.75 (High)
Available nitrogen (N)	kg ha^{-1}	<280 (Low)	280-560 (Medium)	>560 (High)
Available phosphorus (P_2O_5)	kg ha^{-1}	<12.5 (Low)	12.5-25 (Medium)	>25 (High)
Available potassium (K_2O)	kg ha^{-1}	<135 (Low)	135-335 (Medium)	>335 (High)
Available sulphur (S)	kg ha^{-1}	<22.5 (Low)	22.5-35 (Medium)	>35 (High)
Available zinc (Zn)	ppm	<0.6 (Low)	0.6-1.0 (Medium)	>1.0 (High)

Table.2 Analysis results of chemical parameters of soil samples of Pathalgaon and Bagicha Block in Jashpur District, Chhattishgarh

Farmers	pH (w/v)			EC (dSm^{-1})			Organic Carbon (%)			Nitrogen (Kg ha^{-1})			Phosphorous (Kg ha^{-1})			Potassium (Kg ha^{-1})			Sulphur (Kg ha^{-1})			Zinc (Kg ha^{-1})		
	Village Name			Village Name			Village Name			Village Name			Village Name			Village Name			Village Name			Village Name		
	Kamarema	Gala	Kodkelkhajri	Kamarema	Gala	Kodkelkhajri	Kamarema	Gala	Kodkelkhajri	Kamarema	Gala	Kodkelkhajri	Kamarema	Gala	Kodkelkhajri	Kamarema	Gala	Kodkelkhajri	Kamarema	Gala	Kodkelkhajri	Kamarema	Gala	Kodkelkhajri
F_1	5.94	5.54	5.54	0.06	0.11	0.11	0.46	0.47	0.44	182.2	209.0	212.50	11.60	12.60	11.60	150.0	126.5	123.5	26.71	33.20	32.60	1.94	2.10	4.74
F_2	6.10	6.19	6.19	0.09	0.08	0.08	0.44	0.51	0.47	190.1	216.0	214.60	16.60	12.40	14.50	154.6	121.9	109.3	29.31	32.60	31.26	1.84	3.12	3.21
F_3	5.64	6.20	6.20	0.11	0.12	0.09	0.47	0.60	0.44	184.2	211.3	219.60	14.20	13.90	11.60	140.3	131.9	111.6	33.20	31.26	30.10	1.96	2.91	3.96
F_4	5.54	6.10	5.96	0.08	0.06	0.11	0.51	0.44	0.47	187.5	213.0	213.90	11.20	16.10	14.70	133.2	121.3	120.6	32.60	26.71	29.31	1.77	2.46	3.46
F_5	6.19	5.94	5.64	0.12	0.09	0.08	0.60	0.47	0.51	201.2	221.2	217.90	13.60	15.40	10.50	144.7	114.9	108.6	31.26	29.31	33.20	2.10	3.61	2.91
F_6	6.20	6.10	5.54	0.08	0.11	0.12	0.42	0.60	0.63	191.3	219.0	224.60	15.40	11.80	11.90	161.8	123.6	103.6	30.10	33.20	32.60	1.99	3.21	3.01
F_7	5.92	5.64	6.19	0.11	0.08	0.08	0.48	0.42	0.51	186.9	213.1	223.60	12.40	10.60	15.90	146.5	128.9	118.6	29.36	32.60	26.71	2.30	1.96	3.67
F_8	5.78	5.54	6.51	0.04	0.12	0.14	0.47	0.47	0.60	195.6	217.0	231.50	11.90	14.60	11.80	133.3	120.9	146.8	32.32	31.26	29.31	1.70	3.21	2.98
F_9	5.42	6.10	6.31	0.09	0.11	0.16	0.53	0.51	0.42	212.0	214.0	236.25	12.60	11.90	9.40	120.5	124.5	101.4	28.27	30.10	25.87	3.37	2.89	3.12

Table.3 Recommendation of chemical fertilizer Based on Soil test of Pathalgaon and Bagicha Block in Jashpur District, Chhattishgarh

Farmers	Kamarema					Gala					Kodkelkhajri				
	N applied (kg/ha)	P applied (kg/ha)	K applied (kg/ha)	S applied (kg/ha)	Zn applied (kg/ha)	N applied (kg/ha)	P applied (kg/ha)	K applied (kg/ha)	S applied (kg/ha)	Zn applied (kg/ha)	N applied(kg/ha)	P applied(kg/ha)	K applied(kg/ha)	s applied(kg/ha)	Zn applied(kg/ha)
F_1	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00
F_2	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00
F_3	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00
F_4	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00
F_5	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00
F_6	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	80.00	40.00	0.00	0.00
F_7	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	80.00	40.00	0.00	0.00
F_8	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	80.00	40.00	0.00	0.00
F_9	106.00	60.00	30.00	0.00	0.00	106.00	60.00	40.00	0.00	0.00	106.00	80.00	40.00	0.00	0.00

Table.4 Siliqua per plant

Treatment	Kamarima	Gala	Kudkelkhajari
Farmer -1	85.57	96.98	85.57
Farmer -2	85.57	72.94	89.65
Farmer -3	92.91	98.61	97.8
Farmer- 4	96.98	93.72	96.17
Farmer -5	66.83	101.87	109.21
Farmer -6	70.90	72.94	81.5
Farmer -7	70.09	110.02	77.42
Farmer -8	81.5	101.87	79.05
Farmer -9	80.02	89.65	85.57

Table.5 Mustard yield Q/ ha

Treatment	Kamarima Village	Gala Village	Kudkelkhajari Village
Farmer -1	10.50	11.90	10.50
Farmer -2	10.50	8.95	11.00
Farmer -3	11.40	12.10	12.00
Farmer- 4	11.90	11.50	11.80
Farmer -5	8.20	12.50	13.40
Farmer -6	8.70	8.95	10.00
Farmer -7	8.60	13.50	9.50
Farmer -8	10.00	12.50	9.70
Farmer -9	10.80	11.00	10.50

Fig.1 Availability of pH at different village of Jashpur District

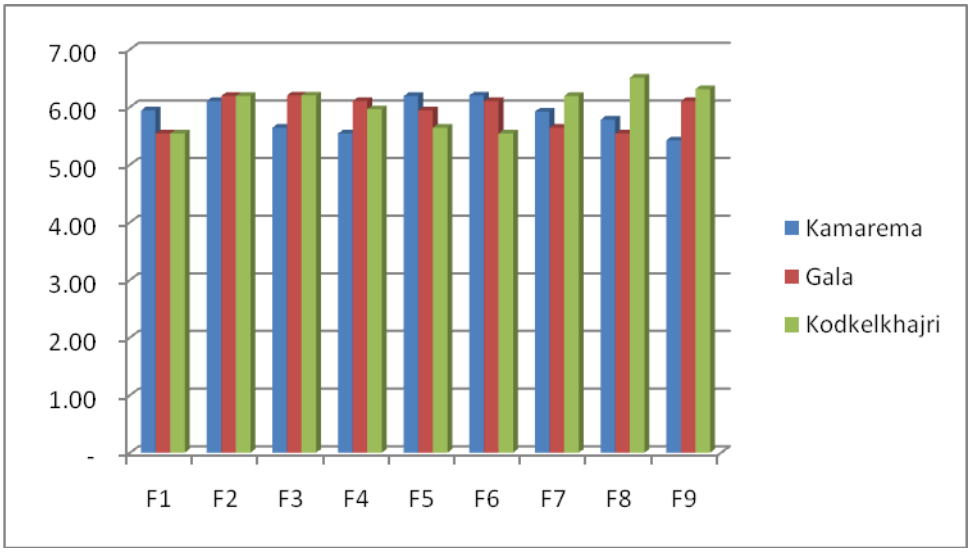


Fig.2 Availability of Ec at different village of Jashpur District

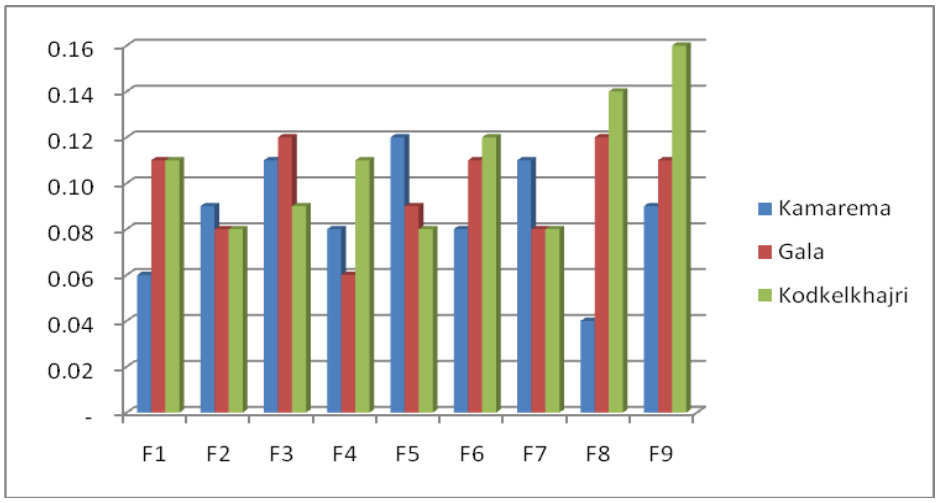


Fig.3 Availability of OC at different village of Jashpur District

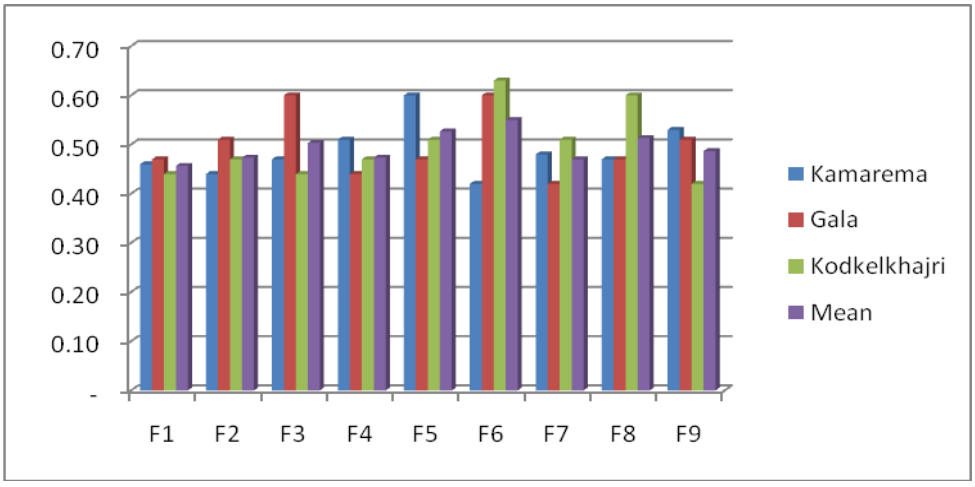


Fig.4 Availability of Nitrogen at Different Village of Jashpur District

Fig.5 Availability of phosphorus at different village of Jashpur District

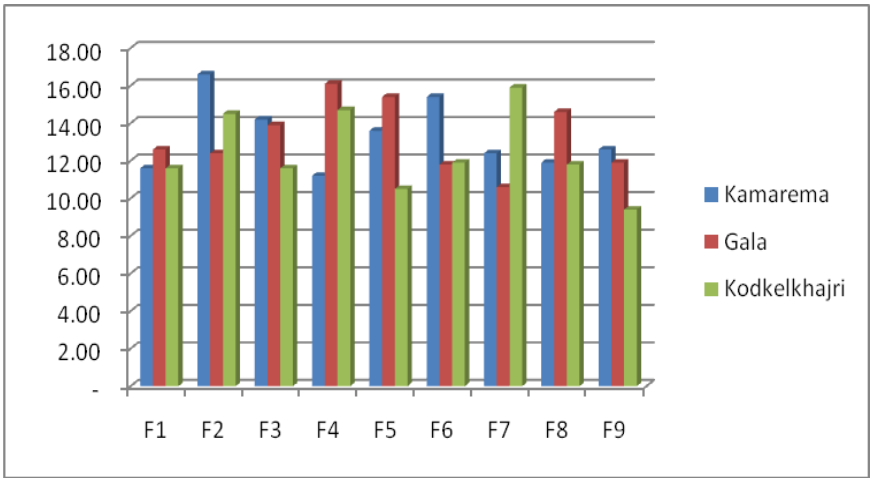


Fig.6 Availability of potassium at different village of Jashpur District

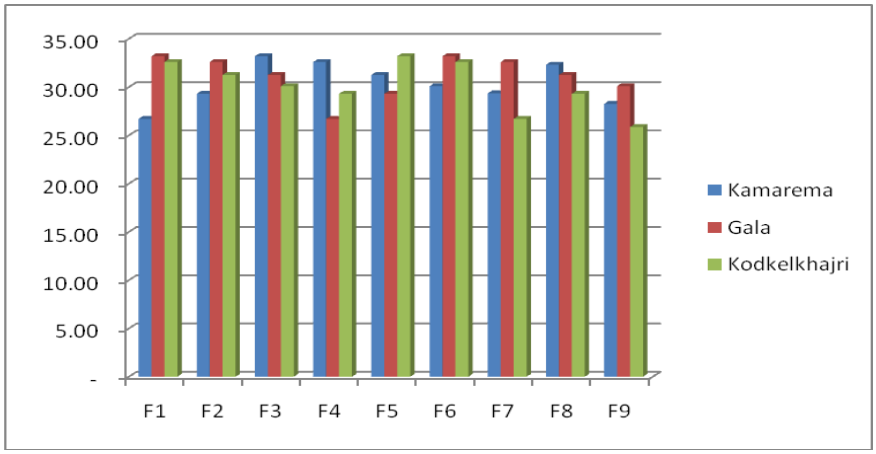


Fig.7 Availability of sulphur at different village of Jashpur District

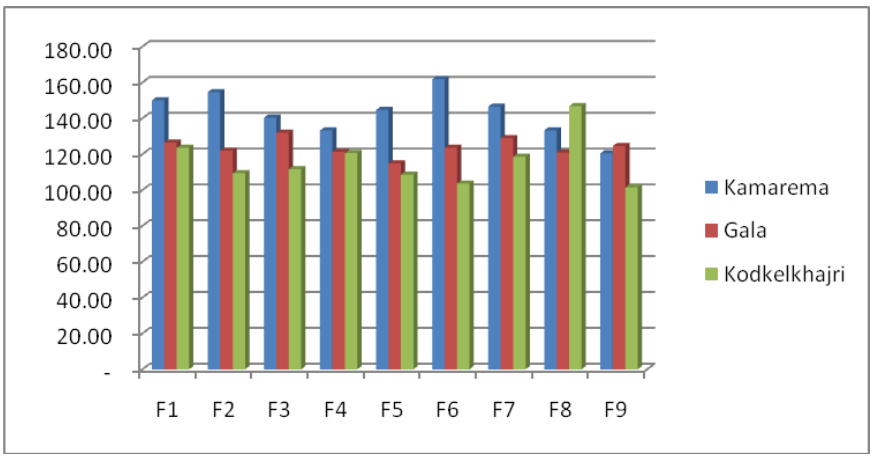


Fig.8 Availability of zinc at different village of Jashpur District

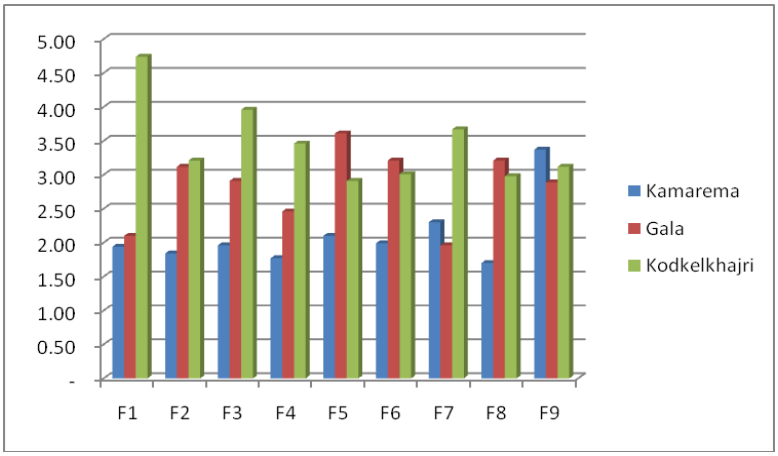


Fig.9 No. of siliqua on mustard crop at different village of Jashpur District

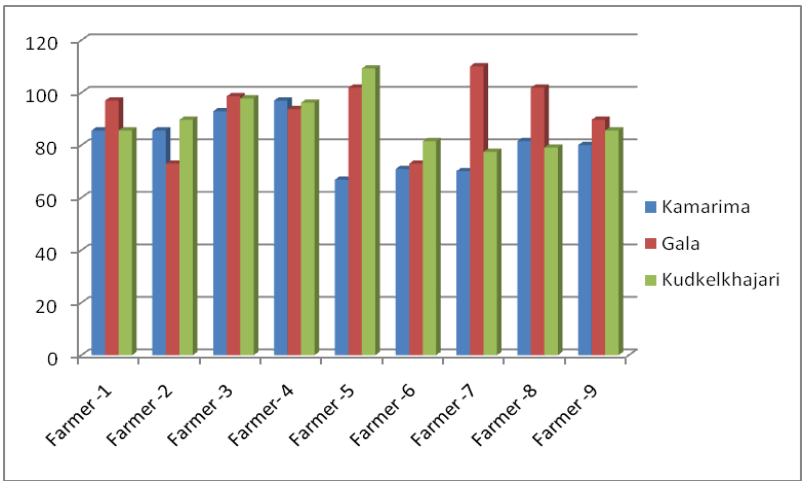
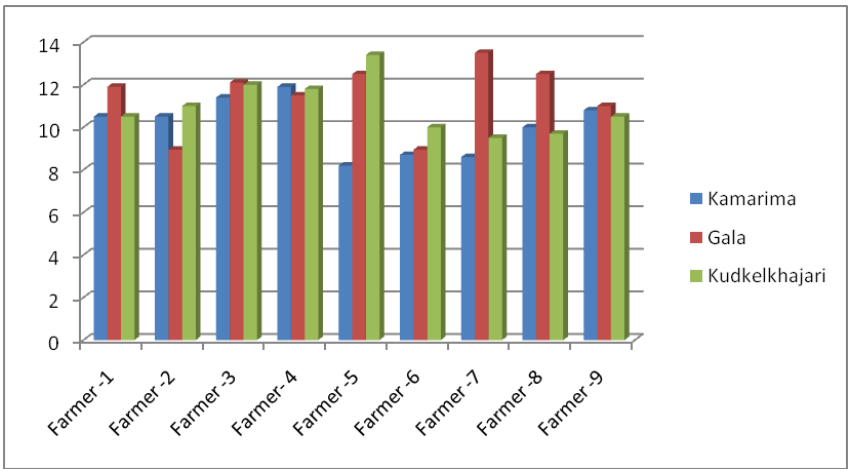


Fig.10 Mustard crop yield at different village of Jashpur District



Available zinc (kg ha^{-1})

The lowest value of zinc (ppm) is found in soil of Kamaremaat depth (0-15 cm) 1.70 kg ha^{-1} and highest value in soil of Kodkelkhajriat depth (0-15cm) 4.74kg ha^{-1}.

The available zinc (kg ha^{-1}) was found to be non-significant at different depths and villages (Fig. 8).

It can be concluded that the soil of Pathalgaon and Bagicha Block in Jashpur district of Chhattisgarh showed status according to Table 1. The value of pH is found varied from 5.42 to 6.51. It is neutral in nature, similarly results reported by (Meena *et al.,* (2006). The EC value is varied from 0.04 to 0.16 dSm^{-1} and it is normal, similarly results found (Upadhyay *et al.,* 2014). The value of OC percent is found in varied from 0.44 to 0.63 per cent and this is low to medium level. The value of available nitrogen (kg ha^{-1}) is found in varied from 182.2 to 236.25 kg ha-1 is low to medium level similarly results reported by Pandey *et al.,* (2013).

The value of available phosphorus (kg ha^{-1}) is found in varied from 9.40 to 16.6 kg ha^{-1} is medium level. The value of available potassium (kg ha^{-1}) is found in varied from 101.4 to 170.3 kg ha^{-1} is medium level similarly results reported by (Rao *et al.,* 2012). The value of available zinc (kg ha^{-1}) is found in varied from 1.70 to 4.74 kg ha^{-1} is medium to high level. The value of available sulphur (kg ha^{-1}) is found varied from 25.87 to 33.2 kg ha^{-1} is medium level (Table 2).

Siliqua (per plant)

The lowest value of Siliqua (per plant) is found in Mustard crop of Kamarema at 66.83 per plant and highest value in Mustard crop of Gala 110.02Siliquaper plant. The available Siliqua (per plant) was found to be significant at different villages (Fig. 9).

Yield (Q/ha.)

The lowest value of yield (Q/ha.) is found in Mustard crop of Kamaremaat 8.20 (Q/ha.) and highest value in Mustard crop of Gala 110.02 Yield (Q/ha.). The available yield (Q/ha.) was found to be significant at different villages (Table 3 and 4).

It is concluded that the best Cropping sequence with recommended doses of fertilizer also increased the fertility status of soil. The Maximum Mustard yield, Maximum Siliqua and best growth result of Mustard crop in Pathalgaon and Bagicha block of Jashpur district (Fig. 10).

Abbreviations

Q/ha.: Quintal/hactare
Kg/ha.: Kilogram/hactare
% : Percent
dSm^{1}.: Desi Simom Per Meter
cm: Centimeter
mm : Milimeter
PPM: Parts Per Million
Ph: Proton of Hydrogen
EC: Electrical Conductivity
OC: Organic Carbon
N: Nitrogen
P: Phosphorus
K: Potassium
Zn: Zinc
S: Sulphur
G: gram
Kcal: Kilo Calorie

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