Original Research Article

DISTRIBUTION OF MACRO NUTRIENTS IN SURFACE AND SUBSURFACE SOILS UNDER SAFFRON GROWING AREAS OF PULWAMA DISTRICT OF JAMMU & KASHMIR

Abstract

One hundred eighty (180) composite soil samples were collected from surface and subsurface layers from 18 saffron growing villages of Pulwama district to study the available primary and secondary nutrient status of the soils. None of the soil were found to be deficient in available nitrogen, phosphorous, potassium, calcium, magnesium and sulphur. The soils were medium in available nitrogen and phosphorous and medium to high in potassium with mean values of 338.46, 21.25 and 258.83 kg ha^{-1} respectively in surface soils (0-15 cm) and mean values of 318.07, 18.82 and 232.03 kg ha^{-1} respectively in sub-surface soils (15-30 cm). All the soils were high in available calcium and magnesium with average values of 1677.1, 317.7mg kg^{-1} and 1692.5 and 352.3mg kg^{-1} in surface and subsurface soils respectively. The soils were low to medium in available sulphur content with surface and subsurface sulphur content of 10.51 and 8.70 mg kg^{-1} respectively.

Keywords: Saffron growing soils, Pulwama, Available primary and secondary nutrients

1. INTRODUCTION

The term "saffron" is derived from "Zaffran," the Arabic name for this spice. In India, it is also known as "Kesar" and holds a traditional significance in culinary practices. Saffron (*Crocus sativus* L.) belongs to the Iridaceae family and is the sole economically significant product obtained from any Crocus species. The herb is believed to have originated in Greece, Asia Minor, and Persia, gradually spreading eastwards to China and Kashmir. The saffron plant has adapted to a Mediterranean-type climate and thrives in temperate conditions at altitudes ranging from 1500 to 2400 meters above mean sea level (MSL). Its cultivation spans a vast geographical range, extending nearly 90 degrees' longitude (from Spain to Kashmir) and 25 degrees' latitude (from England to Persia). Saffron gained popularity as a medicinal substance during the Arab regime, leading to its cultivation in Spain around 921 A.D.

Subsequently, its cultivation expanded to neighbouring countries in southern Asia and Europe[1].

India occupies the second largest area and produces approximately 7 per cent of the total world production. Jammu and Kashmir is enjoying monopoly to grow this crop in the country and is being cultivated in Pulwama, Srinagar, Budgam and Kishtwar districts over an area of 3657 ha during 2022.According to reports from the Directorate of Agriculture, Jammu and Kashmir, there has been no significant increase in saffron production, and a notable decline in productivity has been observed. The productivity decreased from 2.80 kg per hectare in 1996-97 to 1.88 kg per hectare in 2016. Recognizing the impact of soil nutrients on saffron productivity, a soil nutrient survey was conducted to assess the fertility status of saffron growing soils in the Pulwama district.

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2. MATERIALS AND METHODS

The study area i.e., Pulwama district is situated between the geographical coordinates of 33º37' to 34º 06' N Latitudeand 74º33' to 75º14' E Longitude and 1500 to 2000 m amslaltitude is bounded by Srinagar in the North, Budgam in the West and Anantnag in the south. The areaexperiences typical sub-humid temperate climate andqualifies for udic moisture regime dominantly and mesic orwarmer temperature regime. The physiography is highlyuneven characterized by moderately steep to very steepslopes in upper reaches, moderately undulated at midelevated plateaus (Karewas) and flat to moderately sloping land under cultivation and near habitation.

One hundred eighty (180) composite soil samples were collected from two depths *viz.,* 0-15 cm and 15-30 cm from 18 saffron growing villages (Fig. 1) of Pulwama district by following simple random sampling method. The collected composite samples were air dried in shade and after drying the samples were ground with wooden pestle and mortar and sieved by using 2mm sieve to separate coarse fragments (>2mm). The sieved sample was used for analysing various soil parameters. Available Nitrogen was determined by alkaline permanganate method as described by Subbiah and Asija [2].Available phosphorous content of soil was extracted by 0.5N sodium bicarbonate at pH 8.5 [3] and was estimated by ammonium molybdate method as described by Jackson [4]. Available potassium was extracted with neutral normal ammonium acetate and the content of potassium was estimated by using flame photometer. Available sulphur in soil was determined by turbidimetry method as described by Chesnin and Yien [5]. Calcium and magnesium content in the soil samples were determined by versenate titration method [4].

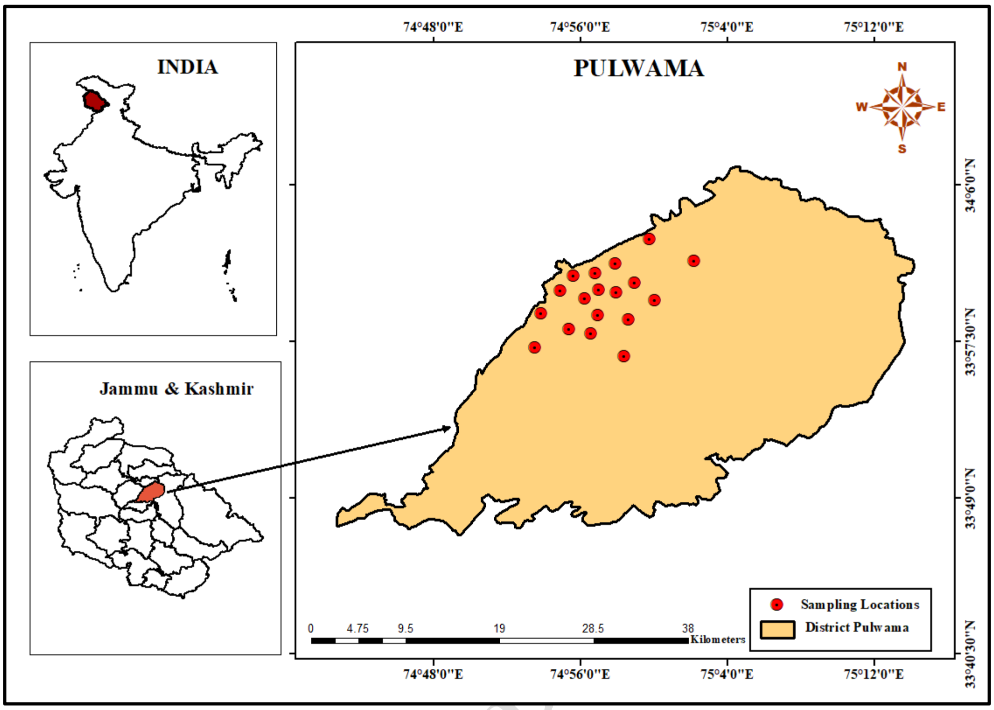

Fig 1: Study area map of Pulwama District

3. RESULTS AND DISCUSSION

3.1 Primary nutrients

The primary nutrient status of saffron growing soils of Pulwama district is presented in table 1. The available nitrogen content of surface and subsurface soils varied from 274.1 to 413.2 and 251.8 to 391.2 kg ha^{-1} with mean values of 338.46 and 318.07kg ha^{-1}respectively.Nitrogen content of surface soils was found to be higher than subsurface soils and showed a decreasing trend with depth. The available nitrogen exhibited significant variation among the different locations. Nitrogen content in these soils was found in medium range. Thedecreaseinavailablenitrogenwithincreaseinsoil depthmay be due to presence of high organic matter content and favourable environmental conditions for mineralization in surface layers than in sub-surface layers. The variationinnitrogencontentamongdifferentlocationsisduetovariationin climaticandphysiographicconditions andorganicmattercontent.Theresults are in agreement with the findings of Dar [6], Singh andRathore [7], andBhat[8].

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Table 1: Available primary nutrient status of saffron growing soils under Pulwama district

Location	Available Nitrogen (Kg ha^{-1})		Available Phosphorous (Kg ha^{-1})		Available Potassium (Kg ha^{-1})	
	0-15 cm	**15-30 cm**	**0-15 cm**	**15-30 cm**	**0-15 cm**	**15-30 cm**
Konibal	329.6	315.4	20.35	18.16	284.2	259.8
Pompore	308.1	292.3	20.84	18.37	270.4	257.2
Samboora	290.5	276.4	18.31	16.73	188.6	165.2
Baras	397.3	378.2	24.19	21.75	226.0	208.2
Mueej	378.2	355.8	24.00	21.94	238.4	214.2
Krunchoo	274.1	253.4	17.02	15.37	201.0	183.8
Wuyen	349.8	321.0	21.70	19.42	228.4	214.4
Munpur	413.2	391.2	26.91	22.78	317.2	297.6
Lethpora	304.8	291.8	19.10	17.09	286.8	247.2
Ladhu	334.6	310.6	21.05	18.90	244.6	226.8
Chandhara	278.0	251.8	17.13	14.01	335.6	310.8
Dussu	344.1	323.6	21.60	19.51	295.4	263.4
Khrew	332.0	317.6	21.47	18.85	220.0	171.0
Kakapora	408.2	376.0	25.23	22.45	225.8	182.4
Zaintrag	399.4	376.4	24.68	22.13	297.2	267.8
Namblabal	283.5	269.3	18.62	16.09	312.0	278.8
Kadlabal	296.2	272.0	18.30	15.32	204.6	174.0
Sharshali	370.3	351.6	22.09	19.91	282.8	254.0
Range	274.1-413.2	251.8-391.2	17.02-26.91	14.01-22.78	188.6-335.6	165.2-310.8
Mean	338.46	318.07	21.25	18.82	258.83	232.03
SEM	11.06	10.62	0.68	0.63	10.46	10.64

Available phosphorus of surface soils varied from 17.02 to 26.91 kg ha^{-1},withameanvalueof21.25kg ha^{-1},whereas,insubsurfacesoilsitrangedfrom 14.01 to 22.78 kg ha^{-1}, with a mean value of 18.82 kg ha^{-1}. The available phosphorusshowedadecreasingtrendwithanincreaseinsoildepth.The available phosphorus status of soils under study was found in medium range. The results are in accordance with Similarresultswereobtainedby Dar [6]andKumar[9] . The high amount of available phosphorus in surface layers as compared to sub-surface layers may be due to high amount of organic matterin surface soils, which decreaseswith depth.The present findings areinlinewiththeresults obtainedby Fida[10]andBhat[8]. The available phosphorus content in soils of different locations varied significantly with high content in soils with high organic matter followed. This could beattributed to favorable soil reaction and high organic matter content leading to the formation of organophosphate complexes and coating of iron and aluminumparticles by humus. This is supported by the research work of Singh and Bhandari [11], Akhter [12] and Wani [13].

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The present study revealed that the available potassium of surface and subsurface soils ranged between 188.60 to 335.60 kg ha^{-1} and 165.20 to 310.80 kg $ha^{-1}$with mean values of 258.83 and 232.03 kg ha^{-1} respectively.The status of available potassium was observed between medium to high. It maybe due to prevalence of potassium rich clay minerals like illite and application of potassium fertilizers as well as manures. These results are further supported by the findings of Dar [6] and Fida [10].

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3.2 Secondary nutrients

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The secondary nutrient status of saffron growing soils of Pulwama district is presented in table 2.It was observed that exchangeable calcium content of surface soils ranged from1487.0to1841.2mgkg^{-1}withameanvalueof1677.1mgkg^{-1},whereas, insub-surfacesoilsitvariedfrom 1494.2to1855.7mgkg^{-1}withameanvalue of 1692.5mg kg^{-1}.Available calciumof sub-surfacelayerswashigh thanthatofsurfacelayersanditshowedanincreasing trendwithanincreasein soil depth. The saffron growing soils under study were found to be high in availablecalcium.Theseresultsareinaccordance with the findings of Wani [14] and Dar [6]. Exchangeable calcium was highin the soils. It may be due to presence of calcium rich minerals with substantial quantities of dolomite and shale, which

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Table 2: Available secondary nutrient status of saffron growing soils under Pulwama district

Location	Calcium ($mg\ kg^{-1}$)		Magnesium ($mg\ kg^{-1}$)		Sulphur ($mg\ kg^{-1}$)	
	0-15 cm	**15-30 cm**	**0-15 cm**	**15-30 cm**	**0-15 cm**	**15-30 cm**
Konibal	1787.4	1794.0	314.4	347.2	8.32	7.69
Pompore	1841.2	1855.7	298.2	323.3	11.56	9.61
Samboora	1487.0	1494.2	334.0	365.2	7.36	6.12
Baras	1775.4	1789.2	341.2	380.0	12.57	10.35
Mueej	1631.8	1653.4	387.8	413.6	8.51	7.61
Krunchoo	1690.3	1701.0	311.6	342.8	8.63	6.14
Wuyen	1568.4	1575.3	239.3	286.1	11.32	9.21
Munpur	1760.1	1771.9	287.9	329.7	12.02	10.01
Lethpora	1776.2	1794.6	332.2	363.1	7.09	5.69
Ladhu	1727.1	1756.2	345.3	399.4	13.29	11.58
Chandhara	1821.1	1843.0	287.3	315.8	12.07	8.64
Dussu	1676.9	1691.3	327.5	372.4	14.68	12.60
Khrew	1667.3	1683.5	339.6	364.5	12.69	10.39
Kakapora	1698.9	1721.4	375.4	399.7	8.66	7.64
Zaintrag	1564.7	1582.2	302.7	337.1	13.27	11.64
Namblabal	1638.4	1657.2	321.5	348.2	9.24	7.61
Kadlabal	1491.2	1502.8	304.2	357.3	8.31	6.51
Sharshali	1584.0	1597.8	268.8	296.2	9.56	7.63
Range	1487-1841.2	1494.2 -1855.7	239.3 -387.8	286.1 -413.6	7.09-14.68	5.69-12.60
Mean	1677.1	1692.5	317.7	352.3	10.51	8.70
SEM	25.36	25.80	8.44	8.16	0.55	0.63

encircle whole valley ofKashmirin theformofcliffsasreportedby Wadia[15].Thecalcareousnature of parental material as reported by Handoo [16] may alsobe a responsible for highavailablecalciumcontentofthesesoils.Theseobservationswerealso reported by the findings of Dar [17] and Bhat [8].The calcium content of the soils increased with depth which may be due to leaching of calcium from surface to sub-surface layers. The results are in agreement with those ofAhmad [18] and Bhat [8].The variation of available calcium among differentlocationsmaybeduetodifferenceinamountofcalciumbearing minerals, pH of soils and elevation. These results are further supported by the findings of Yogeeshappa[19], Shaaban and El-Fouly [20] and Masrat [21]

The available magnesium content ofsurfaceandsub-surfacesoilsvariedfrom239.3 to 387.8 mgkg^{-1} and 286.1 to 413.6 mgkg^{-1} with mean values of 317.7 and 352.3 mg kg^{-1}, respectively. It was also observed that available magnesium content showed an increasing trend withsoildepth and sub-surfacesoilswerehighinavailablemagnesium than surface soils. Available magnesium content was high in these soils. Similarresultswerealsoreportedby Talib [22] and Bhat [8]. Available magnesium content in soils under study was observed high, which may be due to presence of dolomite and chlorite type of minerals in Kashmir as reported by Najar [23]. The results are further supported by the findings of Dar [17], Masrat [21], Bhat [8], and Wani [13]. Magnesiumconcentration showed an inconsistent trendwith soil depth. Similar results were observed by Singh [24], who also didn't observe any definite relationship of exchangeable magnesium with soil depth. Dar [6], while studying the effect of altitude on nutritional status of soils of Kashmir valley also reported that the available magnesium did not exhibited any consistent trend in its vertical distribution.

The availableSulphur was in the range of 7.09 to 14.68 mg kg^{-1} with a mean value of 10.51 mg kg^{-1} in surface soils,whereas,insub-surfacesoilsitvariedfrom5.69-12.60 mgkg^{-1}withamean value of8.70mg kg^{-1}.Surfacesoilswerehighin available sulphur thansubsurface soils. The available sulphur showed decreasing trend with thesoildepth.The results are supported by the findings of Antoo [25] and Masrat[21]. Thesoils were found low to mediuminavailablesulphurcontent.This may be attributedtothe temperateclimate resulting in lowmineralization of organicmatter,hencelowreleaseof availablesulphur.Theresults arein conformity with the findings of Sharma and Bhandari [26], Masrat[21]and Wani [13]. Surface soils were high in available sulphur than sub-surface soils.Thismay be attributed to high content of organic matter present in surface soils as comparedtosubsurfacesoils.Theresultsaresupportedby thefindingsofArora [27] and Wani

[14].

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4. CONCLUSION

The study's findings indicate that the saffron growing soils in the Pulwama district are characterized as having medium levels of available nitrogen and phosphorus, and medium to high levels of potassium. Calcium and magnesium were observed to be in the high range, while available sulphur was in the low to medium range. This investigation provides valuable insights into the fertility status of saffron growing soils in the Pulwama district. The information gathered will contribute to the development of a nutrient management plan aimed at enhancing saffron productivity.

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