

Studies on irrigation water quality and coleus yield traits and yield on various coleus growing agro climatic zones of Tamil Nadu (Coleus forskohlii)

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ABSTRACT

A field survey was under taken to study the irrigation water quality on yield variation of coleus in various coleus growing agro climatic zones of Tamil Nadu, for that bench mark detailed irrigation water survey was conducted in high, medium and low yielding villages of coleus growing five agro climatic zones namely north eastern, hill area, north western, western and southern agro climatic zones of Tamil Nadu during the year 2012-13 where coleus crops growing regularly during Sep-Oct months every year. About 44 irrigation water samples were drawn from wells and subjected to detailed analysis in the laboratory following the standard procedure for pH, EC, anions (carbonate, bicarbonate, chloride and sulphate), cations (calcium, magnesium, sodium and potassium), and computation of indicators like residual sodium carbonate (RSC), sodium adsorption ratio (SAR), magnesium calcium ratio and geo chemical type etc. The analytical results revealed that 35 water samples Electrical conductivity is less than 1.0. Eight samples recorded EC value of 1-2 and only one water sample recorded EC value of 2-4 range. Regarding geochemical type 22 samples recorded Magnesium bicarbonate type geochemical type, 3 samples recorded Magnesium chloride type, five samples recorded calcium chloride geochemical type and 14 samples recorded calcium bi carbonate geo chemical type.

Key words: Coleus, Forskolin, irrigation water, agro climatic zones.

INTRODUCTION

Soil and water are the important resources for crop production. One of the first major innovations of man in his quest for food was irrigation of land. Presently agriculture is the major user of the country's water resources. In this context knowing the quality of irrigation water of a particular region and their characterization will be much useful to plan the crop and management practices. In India, coleus the plant is found mostly on the dry and barren hills (Anon, 1950). Latitudinal and altitudinal range for the occurrence of the species is between 8° and 31° N and 600 – 800 m, respectively.

Pytochemical investigations have revealed that the plant contains diterpenoids as main constituents together with monoterpenes. Contract farming of *Coleus forskohlii* is gaining popularity among small and marginal farmers of Tamil Nadu, about 10000 tons of *Coleus forskohlii* roots are harvested annually. The yield variation of coleus roots were observed among agro climatic zones of Tamil Nadu. In this paper, effect of irrigation water quality on yield traits and coleus root yield variation of high, medium and low yielding villages of various agro climatic zones were reported.

MATERIALS AND METHODS

A field survey was under taken to study the irrigation water quality on yield variation of coleus in various coleus growing agro climatic zones of Tamil Nadu, for that bench mark detailed irrigation water survey was conducted in high, medium and low yielding villages of coleus growing five agro climatic zones namely North eastern, hill area, north western, western and southern agro climatic zones of Tamil Nadu during the year 2012-13 where coleus crops growing regularly during Sep-Oct months every year. About 44 irrigation water samples were drawn from wells coleus growing villages of five agro climatic zones, and subjected to detailed analysis in the laboratory following the standard procedure for pH, Jackson (1973), EC, anions (carbonate, bicarbonate, chloride and sulphate), cat ions (calcium, magnesium, Jackson (1973) sodium and potassium Stanford and English (1949), and computation of indicators like residual sodium carbonate (RSC), sodium adsorption ratio (SAR), magnesium calcium ratio and geo chemical type etc. Coleus yield traits like no of tubers, length of tubers (cm), girth of tubers (cm), fresh weight of tubers (gm) and dry weight of tubers (gm) were also recorded.

RESULTS AND DISCUSSION

Electrical conductivity (EC):

Salinity status in terms of Electrical conductivity of ground water samples quality analysis of five agro climatic zone coleus crop growing villages is presented in the table.1. Perusal of this table reveals that out of 44 irrigation water samples collected, 35 samples recorded EC range less than 1.0 dsm^{-1} . Eight samples recoded the EC range of $1-2 \text{ dsm}^{-1}$ and only one irrigation water sample recorded EC range of $2-4 \text{ dsm}^{-1}$. In general analytical results revealed that majority of water samples recorded the EC range of less than 1.0 dsm^{-1} , non saline in nature. Water uptake by plant roots is increasingly restricted as the concentration of soil salts increases. Irrigation is necessary to help flush out salts and reduce coated stress. The analysis of irrigation water must include the total salt content, pH anion and cat ion composition and content of minor elements for particular importance to the crop involved (US Salinity Laboratory, 1954).

Under the salinity class 2.1 to 4.0 dsm^{-1} more number of villages are in Tuticorin, Salem, Dindigul and Dharmapuri districts and more than 6.0 dsm^{-1} Electrical conductivity also present in Tuticorin, Tirunelveli and Dindigul districts (Velusamy.M and K.Arulmozhi.,2001).

Residual sodium carbonate content (RSC) and Sodium Adsorption Ratio (SAR):

Residual Sodium Carbonate content and Sodium Adsorption Ratio (SAR) of ground water samples quality analysis of all the five Agro climatic zones of coleus crop growing villages is given the table-1. The analytical data reveals that all the water samples collected from various villages of five agro climatic zones are safer limit in RSC and SAR, ie RSC less than 1.25 and SAR less than 10. More than 90% of the bench mark water samples collected from district of Kancheepuram, Thiruvallur, Thiruvannamalai, Erode, Madurai, Kanyakumari, Tuticorin Tirunelveli and Dindigul districts are safer in RSC and also bench mark water collected from district Thiruvallur, Vellore, Thiruvannamalai, Erode, Coimbatore and Madurai districts almost all the villages have the SAR less than 10.0 (Velusamy.M and K.Arulmozhi.,2001).

Geochemical types of irrigation water samples:

Regarding geochemical types magnesium bicarbonate is the dominant geochemical type, twenty two samples recorded magnesium bicarbonate type, fourteen samples recorded calcium bicarbonate, five samples recorded calcium chloride and three samples recorded magnesium chloride geochemical type in all the five agro climatic zones. The analysis of irrigation water must include the total salt content, pH anion and cat ion composition and content of minor elements for particular importance to the crop involved (US Salinity Laboratory, 1954). Limestone contains calcium and magnesium carbonates that are dissolved in association with CO_2 to produce bicarbonates (Johnson., 1972). When ground water is pumped to the surface and discharged through an irrigation system, pH of water often change. This can result in the precipitation of calcium or magnesium carbonates or other minerals to form scale on inside surface of irrigation components. Magnesium bicarbonate water is present in more number of villages in the districts of Dindigul and Dharmapuri districts. Thiruvannamalai district has more percentages of villages with calcium bicarbonate water in Dharmapuri district magnesium bicarbonate type dominant. (Velusamy.M and K.Arulmozhi.,2001).

Table:1-Irrigation water quality analysis of different agro climatic zone of Tamil Nadu

S.no	Name of the village	No of samples collected	EC				RSC			SAR		
			<1	1.1-2	2.1-4	4.1-6	<1.25	1.26-2.5	>2.5	<10	10.1-20	>20
North eastern Zone												
1	HYD	7	7	-	-	-	7	-	-	7	-	-
2	MYD	3	3	-	-	-	3	-	-	3	-	-
3	LYD	7	6	1	-	-	7	-	-	7	-	-
	Total	17	16	1	-	-	17	-	-	17	-	-
Hill area zone												
1	HYD	1	1	-	-	-	1	-	-	1	-	-
2	MYD	1	1	-	-	-	1	-	-	1	-	-
3	LYD	1	1	-	-	-	1	-	-	1	-	-
	Total	3	3	-	-	-	3	-	-	3	-	-
North western Zone												
1	HYD	5	5	-	-	-	5	-	-	5	-	-
2	MYD	6	3	3	-	-	6	-	-	6	-	-
3	LYD	1	-	1	-	-	1	-	-	1	-	-
	Total	12	8	4	-	-	12	-	-	12	-	-
Western zone												
1	HYD	1	1	-	-	-	1	-	-	1	-	-
2	MYD	2	1	1	-	-	2	-	-	2	-	-
3	LYD	3	2	1	-	-	3	-	-	3	-	-
	Total	6	4	2	-	-	6	-	-	6	-	-
Southern zone												
1	HYD	1	1	-	-	-	1	-	-	1	-	-
2	MYD	1	-	1	-	-	1	-	-	1	-	-
3	LYD	4	3	-	1	-	4	-	-	4	-	-
	Total	6	4	1	1	-	6	-	-	6	-	-

HYD- High Yielding Areas, MYD- Medium Yielding Areas, LYD- Low Yielding Areas

Table: 2 - Water quality analysis of coleus growing agro climatic zone of TamilNadu

S.no	Name of the village	No of samples collected	Geochemical types					
			Mgcl ₂	MgHco ₃	Cacl ₂	Nacl	NaHCO ₃	CaHCO ₃
North eastern Zone								
1	HYD	7	-	1	2	-	-	4
2	MYD	3	-	2	-	-	-	1
3	LYD	7	1	2	1	-	-	3
	Total	17	1	5	3	-	-	8
Hill area zone								
1	HYD	1	-	1	-	-	-	-
2	MYD	1	-	1	-	-	-	-
3	LYD	1	-	1	-	-	-	-
	Total	3	-	3	-	-	-	-
North western Zone								
1	HYD	5	-	1	2	-	-	2
2	MYD	6	-	2	-	-	-	4
3	LYD	1	1	-	-	-	-	-
	Total	12	1	3	2	-	-	6
Western zone								
1	HYD	1	-	1	-	-	-	-
2	MYD	2	-	2	-	-	-	-
3	LYD	3	-	3	-	-	-	-
	Total	6	-	6	-	-	-	-
Southern zone								
1	HYD	1	-	1	-	-	-	-
2	MYD	1	-	1	-	-	-	-
3	LYD	4	1	3	-	-	-	-
	Total	6	1	5	-	-	-	-

HYD- High Yielding Areas, MYD- Medium Yielding Areas, LYD- Low Yielding Areas.

Table:3 Coleus plant yield parameters and yield in north eastern and hill area zone

S.no	Particulars	North Eastern Zone			Hill Area Zone		
		Low yield Area	Medium Yield Area	High yield Area	Low yield Area	Medium yield Area	High yield Area
1	No of tubers	14	22	27	16	21	25
2	Length of tubers(cm)	22	28	36	20	25	30
3	Girth of tubers(cm)	6.2	6.8	7	6.8	7.2	8
4	Fresh weight of tubers(gm)	190	250	305	280	380	450
5	Dry weight of tubers(gm)	18.6	23.6	28.8	26.5	37.6	40.2
6	Yield /ha	5000	6925	9250	7875	10700	14750

Table:4. Coleus plant yield parameters and yield - North western, western zone

S.no	Particulars	North Western Zone			Western		
		Low yield Area	Medium Yield Area	High yield Area	Low yield Area	Medium yield Area	High yield Area kg/ac
1	No of tubers	18	28	32	12	16	20
2	Length of tubers(cm)	18	24	30	16	19	21
3	Girth of tubers(cm)	6.6	7.2	7.9	5.8	6.9	8.2
4	Fresh weight of tubers(gm)	540	670	850	140	200	320
5	Dry weight of tubers(gm)	49.1	58.2	77.9	13.2	17.8	28.8
6	Yield /ha	13750	18750	30000	3000	4383	9375

Table:5. Coleus plant yield parameters and yield - Southern zone

S.no	Particulars	Southern Zone		
		Low yield Area	Medium Yield Area	High yield Area
1	No of tubers	14	18	20
2	Length of tubers(cm)	22	28	35
3	Girth of tubers(cm)	6.4	6.9	7.1
4	Fresh weight of tubers(gm)	180	325	420
5	Dry weight of tubers(gm)	18.9	29.1	38.9
6	Yield /ha	2250	6875	10625

Effect of agro climatic zones on yield and yield components of coleus.

The yield contributing traits such as number of tubers, tuber length, and girth and individual tuber weight per plant were influenced by different agro climatic zones. Among the agro climatic zone north western zone cultivated coleus recorded very high in yield components. This might be owing to good soil texture which has good binding in the early stages of growth and good quality irrigation water having lesser amount of soluble salts. Moreover, north western zone coleus cultivating soil provide better drainage and aeration avoiding soil compaction particularly in early stages of growth, which also could have reduced biotic and abiotic stress factors and encouraged better root penetration and high root proliferation (Singh *et al.*, 2001). These results are in conformity with the findings of Rajangam (2006), in coleus Anjaneyulu and Krishnamoorthy (1979) and Gill *et al.* (2004) in turmeric and Mohanty and Sarma (1978) in onion.

The increased tuber production in north western zone agro climatic high yielding areas may also be attributed to establishment of optimum source and sink size by reducing excess vegetative growth. Thus the excessive food material from the top might have accumulated in tuber and consequently increased the size and weight of tubers leading to higher tuber yield. These results confirm the earlier findings of Mishra (1987) in sweet potato. Tubers constitute the economic part of *C. forskohlii* and significant differences in fresh root / tuber yield was observed among the genotypes at stages of 120, 150 and 180 days after planting (Kavitha.,2005).

CONCLUSION

In the present study an attempt has been made to evaluate the irrigation water quality analysis of coleus growing villages of various agro climatic zones. Irrigation water analysis results revealed that about 44 irrigation water samples were drawn from wells of coleus growing villages of five agro climatic zones, and subjected to detailed analysis. The analytical results revealed that 35 water samples Electrical conductivity is less than 1.0. Eight samples recorded EC value of 1-2 and only one water sample recorded EC value of 2-4 range. Regarding geochemical type 22 samples recorded Magnesium bicarbonate type geochemical type, 3 samples recorded Magnesium chloride type,

five samples recorded calcium chloride geochemical type and 14 samples recorded calcium bicarbonate geochemical type. Among the agro climatic zone north western zone cultivated coleus recorded very high in yield components. The increased tuber production in north western agro climatic zone high yielding areas in tuber and consequently increased the size and weight of tubers leading to higher tuber yield.

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