



Reviewed By

Dr. Narendra Singh
Navsari Agricultural University,
Navsari, Gujarat.
Email: n.sing_soilsci@nau.in

*Correspondence

O.P. Aishwath
aishwath1@yahoo.com

Received: 01 January 2024

Revision: 13 January 2024

Accepted: 14 February 2024

Citation

Aishwath, O.P., Mehta, R.S., Dubey, P.N. and Harisha, C.B. 2022.
Coriander response to potassium under its medium availability in Typic Haplustepts. *Int J Seed Spices*.12 (1), 59-64

DOI

<https://doi.org/10.56093/IJSS.v12i1.7>

Affiliation

ICAR-National Research Centre on
Seed Spices, Tabiji-305 206, Ajmer,
Rajasthan, India

Coriander response to potassium under its medium availability in Typic Haplustepts

O.P. Aishwath, R.S. Mehta, P.N. Dubey and Harisha, C.B.

Abstract

Field experiments were carried out with seven levels of potassium (K) (as $K_2O\ ha^{-1}$) using coriander (var. Ajmer coriander-1) on a medium fertile sandy loam soil (*Typic Haplustepts*). These results revealed that plant height and secondary branches were lower at higher level of K, while the growth, yield and associated attributes were statistically ($p<0.05$) *at par* with control. The reduction in seed yield per pot was 4.2 to 8.3 % beyond soil application of 40 kg $K_2O\ ha^{-1}$. There was no significant ($p<0.05$) variation in seed nutrient content, except N and K uptake. The N content in seed was higher at 120 kg $K\ ha^{-1}$, while K content in seed was more beyond the 60 kg of applied K. Nutrient content in coriander straw increased marginally with increase in doses of K. Uptake of nutrients and sodium (Na) content decreased with increase in doses of K. Potassium availability was more with higher doses of K; beyond the 40 kg $K\ ha^{-1}$ and rest of nutrient remained *at par* with doses of K. Soil exchangeable Na was enhanced slightly with doses of K and soil accumulation was more than its initial level. Therefore, it is recommended that there is no need to apply K in coriander, if sufficient availability of K is there in soil and irrigation water bears an appreciable amount of K. Moreover, higher application of K and deep irrigations (>50mm) makes coriander susceptible for frost injury, if it occurs and ultimately reduces crop yield.

Keywords: Potassium, coriander, yield, uptake of nutrients and soil nutrients, frost damage.

Introduction

Among the major nutrient, potassium (K) is usually the most abundant in soils. Total K in soils varies from 0.5-2.5% of the soil mass. The most of the K exists in mineral form as K-feldspars and micas and releases by weathering or dissolution of K from these minerals (Singh and Singh, 2007). The phyllosilicates fix and release K for plants from non-exchangeable forms (Florence *et al.*, 2017). Potassium ions present on the exchange sites are adsorbed by outer-sphere complex which are easily available for uptake by plant. whereas, illite, vermiculite, and interstratified 2:1 clay mineral release, fixed or non-exchangeable K from interlayer sites through cation exchange and diffusion processes with slower rates than the exchangeable K (Florence *et al.*, 2017). Likewise, the ammonium ions, K^+ ions can be fixed in the interlayers of the 2:1 mineral (Murrell *et al.*, 2021). The fixed/non-exchangeable K can be released back into soil

solution, if the concentration of K falls below its threshold value. For the growth and development of perennial spices, K is the second most important nutrient element next to nitrogen as per requirement among the major nutrients (Sadanandan, 1998). Potassium is known to play a vital role in photosynthesis and carbohydrate formation in perennial spices particularly in acidic soils. It plays a key role in the activation of various enzymes in plants. To maintain the turgor pressure, potassium is necessary in young growing tissues for cell elongation and also for cell division. It is a highly mobile nutrient in plant; hence it translocates easily to maintenance turgor pressure in apical meristem. It supports several physiological processes and uptake of other nutrient elements in plants. It also improves the yield and quality of perennial spices in acidic soils (Sadanandan, 1993).

Coriander (*Coriandrum sativum* L.) is one of the most important seed spice crops belongs to *Apiaceae* family, cultivated in almost all the states of India. Its vernacular name in Hindi is *Dhania*. The stems, leaves and seeds of coriander are used in a number of culinary preparations and as flavouring agents. Dry seeds are extensively used in the form of powder against flatulence, indigestion, vomiting and intestinal disorders. It is one of the earliest spices and used by mankind Luaza *et al.*, (1996). In spite of multiple uses of coriander, it commercially cultivated majorly in Gujarat and Rajasthan. The work done on production and productivity with proper nutrients in various soil conditions in India is limited (Mishra *et al.*, 2016). Some of the worker on coriander reported that application of potassium at 60 kg ha⁻¹ along with zinc sulfate 30 kg ha⁻¹ gave significantly higher plant height, dry matter yield, seed yield and No. of seed per umbellate of coriander (Monali *et al.*, 2019). Mishra *et al.*, (2016) reported positive response N and K and their interaction on growth and yield of coriander in acidic soils of Orissa. Encouraging results of K in coriander were also reported by various workers are Bhoya (2008), Singh (2011), Moniruzzaman *et al.*, (2014) and Yousuf *et al.*, (2014). Besides response of coriander to K, effect of composts on growth and yield of crop and uptake pattern of nutrients in various cultivars studied by Aishwath and Anwer (2016) and Aishwath, *et al.*, (2018), respectively. The requirement of fertilizer for any crop varies with the cultivars and soil types in agro ecological zones (Mitra *et al.*, 1990 and Aishwath and Anwer, 2016). There is no such study on coriander response to K on soil test basis in sandy loam soil of Rajasthan. Therefore, present investigation was carried out in pot culture to assess the response of coriander to K.

Materials and methods

Location and climate

The field experiments were carried out for two consecutive years under the *Typic Haplustepts* during *Ravi* season of 2013–14 and 2014–15 at ICAR-National Research Centre on Seed Spices, Tabiji, Ajmer, Rajasthan, India. This was laid out between 74° 35'39" to 74° 36' 01" E longitude and 26° 22'12" to 26° 22' 31" N latitude. Climate of the Ajmer area characterized as semi-arid. The average annual rainfall of the area is 536 mm and most of it (85-90%) received between June to September. July and August are most rainy months contributing 60.0% of the average rainfall. The moisture control section remains dry for more than 90 cumulative days and hence moisture regime classified as *Ustic*. The mean annual temperature is 24.5 to 25.0°C. January is the coolest month of the season and temperature remain around 7.0°C. Currently frost is also occurring in this month with changing climatic pattern (Singh and Shyampura, 2004).

Treatments and cultural practices

The treatments consisted of seven levels of K (0-80 kg K₂O ha⁻¹). Nutrients amount for the treatments was decided based on the literature searched on the crops and also considered soil availability in the experimental field. All the nutrients were applied as basal dose except N, which was applied in two splits 50% at the time of sowing and 50% before flower initiation. All the seven treatments were arranged in a randomized block design (RBD) with three replications. The coriander varieties Ajmer Coriander-1 (ACr-1) was taken as a test crop for the study on sandy loam soil. Seeds of the coriander variety ACr-1 were sown during last week of October and plant spacing 30cm line to line apart and from plant-to-plant distance was maintained at 10 cm or more by thinning. Cultural practices were uniformly followed during the growing seasons in both the years and crop was irrigated as and when required. The crop was harvested, when it matured during both the years. After harvest, seeds were separated from the stover by beating bundles thereafter winnowing.

Soil analysis and irrigation water analysis

Soil samples were collected from the soil used in pot culture before sowing of seeds and after harvest of crop during both year crops. Samples were air dried and powdered with wooden mortar and pestle and passed through a 2 mm stainless steel sieve. Experimental soil was analyzed for physicochemical properties i.e. EC and pH (Richards, 1954), organic carbon content by rapid chromic titration (Walkley and Black, 1934), available N

by alkaline permanganate (Subbiah and Asija, 1956), available P by 0.5 M NaHCO₃ extractable P (Olsen, *et al.*, 1954) and Bray and Kurtz (1945), available K by 1NNH₄OAc extracts method (Jackson, 1973) and available micro-nutrients (Fe, Zn, Mn and Cu) by DTPA (Lindsay and Norvell, 1978). Texture of experimental soil was sandy loam. Soil E.C., pH and organic C were 0.29dSm⁻¹, 8.25 and 0.22%, respectively. However, soil available N, P and K were 102.6, 8.5 and 250.1 kg ha⁻¹, respectively. Micronutrient status like iron, zinc, manganese and copper in the soil was 10.2, 1.6, 16.1 and 1.8 kg ha⁻¹, respectively. Soil calcium content was >7.5% and exchangeable Na was 553.1 kg ha⁻¹. Irrigation water was slightly sodic in nature having residual sodium carbonate (RSC) 5.4 meqL⁻¹. The E.C., pH and K contents in irrigation water were 1.9dSm⁻¹, 8.5, and 350 ppm, respectively.

Plant analysis

The plant samples were collected after the harvest of crop. These samples were successively washed with tap water thereafter 0.1 M HCl followed by distilled water and then dried at 70°C. After proper drying samples were powdered in wily mill and passed through the 20 mesh stainless steel sieve. Nitrogen was estimated by Kjeldahl method (Piper, 1966). The samples were digested in nitric and perchloric acid (10:4) for the estimation of P by Venado-molybdo yellow color method (Chapman and Pratt, 1962) and K by flame photometer. The Zn, Cu, Fe and Mn were estimated by Atomic Absorption Spectrophotometer (AAS).

Statistical Analysis

The data of both the years were analyzed by ANOVA and treatment differences were expressed for least significant differences (LSD) at $p < 0.05$ probability to determine the significance among the treatment means (Cochran and Cox, 1987).

Results and discussion

Growth yield and their parameters

Plant height measured at the time of maturity could be inferred from the table 1 that it decreased with increased in doses of K. This is because of partially damaged by occurrence of frost just before flower initiation and the damage was bit more where higher doses of K were applied which made it more succulent apical parts. Likewise, secondary branches, number of umbels plant⁻¹, number of umbellate umbel⁻¹ were also reduced down with higher doses of potassium application. It is obvious that more tenderness of younger parts of the plant damaged more due to frost ultimately reduced down

these parameters. Moreover, primary branches, number of seed umbellate⁻¹, and seed and stover yield pot⁻¹ was also lower with increased doses of K as compared to control. The reduction in seed yield pot⁻¹ was 4.2 to 8.34 % beyond the 40 kg K ha⁻¹. This indicates that availability of K in medium to higher level leads to luxury consumption of K, which makes plant susceptible for the frost injury. Besides the medium availability of K in soil, an appreciable amount of K (350 ppm) was also present in irrigation water contributes K in soil by frequent irrigation, hence crop did not respond to K application and further damage caused by frost. Therefore, it is recommended that need not to apply K, if sufficient availability of K is there in soil and irrigation water. Moreover, higher application of K coupled with deep irrigation (>50mm) makes coriander susceptible for frost injury, if it occurs which reduces the crop yield. There was no significant variation within the treatment on yield parameters in coriander was also reported by Bhoya (2008) and Solanki *et al.*, (2017). In contrast to our findings, Solanki *et al.*, (2017) reported that application of 40 kg ha⁻¹ of potassium promoted growth parameters viz., plant height, plant spread, number of branches plant⁻¹ and yield attributes viz., number of umbels plant⁻¹, number of seeds umbellate⁻¹, seed weight plant⁻¹, test weight, seed yield, stover yield over the control in clayey soil having medium status of available N, P, K and S. Likewise, other workers also reported positive response of the K on coriander (Bhoya, 2008; Singh, 2011; Moniruzzaman *et al.*, 2014 and Yousuf *et al.*, 2014).

Nutrient content and uptake

There was no significant variation in seed nutrient content except N and K (Fig 1-4). N content in seed was only higher with 120 kg ha⁻¹ of applied K might be due to split application of N was applied as 50% basal and rest of the 50% at the time of secondary branches initiation, while higher doses of K supported in N metabolism hence the content was more. Potassium content in seed was more beyond the 60 kg of applied K in soil which was at par up to 120 kg K h⁻¹. Nutrient content in coriander straw was not statistically influenced by K application; however, content of macro and micronutrients in both seed and straw was marginally increased with increase in doses of potassium. In contrast to macro or micronutrients, Na content was decreased marginally with increase in doses of K. Uptake of macro and micronutrients did not influence statistically by application of K, however marginally decreased with increase of K doses (Fig 5-6). These findings are in accordance with those of Tripathi (2006) and Tripathi *et al.*, (2009) in coriander.

Soil available nutrients

Nitrogen availability slightly improved by the application of potassium may be due to split application of N retain with more root biomass, these seminal roots decayed and remained in the soil contributed to the organic C and available N (Table 2). Potassium availability was more with higher doses of K; beyond the 40 kg K ha⁻¹, moreover it was at par up to the highest dose of K (120 kg ha⁻¹). This is obvious that more of applied K accumulated in the soil, which was more than the crop requirement. Availability of rest of the nutrients was also not much influenced significantly by application of graded levels of K in soil. However, availability was improved marginally might be due to rhizospheric action be decaying of seminal root after harvest of crop. Soil exchangeable sodium was also estimated as the irrigation water was slightly sodic in nature (RSC 5.4 meq L⁻¹). Results revealed that there was no statistical variation was obtained with increased doses of K, however accumulation was more than the initial level and also slightly more with the doses of K might be due to more organic C retains more of Na, besides that potassium hampers the uptake of Na resulted more of Na in soil with higher doses of K.

Aishwath *et al.*, (2019) reported more availability of K with 10 mg vermi-compost and no variation with 5 mg vermi-compost with the reason that the experimental soil having K bearing minerals which released by intermittently wetting and drying of soils with irrigation water applied to the crop.

Conclusions

Coriander did not respond to potassium fertilization under Sandy loam soil having medium level of available K and an appreciable amount of K contains in irrigation water. Higher application of K makes crop susceptible for frost and reduces the yield of crop. Nutrient content and uptake were not much influenced by K₂O application except N and K. There was no significant variation in soil available nutrients including exchangeable Na except K, which was more beyond 50 kg of K₂O applied.

Acknowledgements

Authors are gratefully acknowledging the Director, ICAR-NRCSS, Ajmer for providing required facilities to carry out the research work smoothly and Mr. Prithviraj M for assistance rendered during the chemical analysis.

Table 1. Effect of potassium application on growth, yield and their parameters of coriander

Treatment	Plant height at maturity (cm)	No of primary branches plant ⁻¹	No of Secondary branches plant ⁻¹	No of Umbel plant ⁻¹	No of Umbellate umbel	No of Seed Umbellate ⁻¹	Seed weight (g pot ⁻¹)	Stover weight (g pot ⁻¹)
K ₀	36.4	4.6	7.8	8.2	4.8	4.8	2.4	11.8
K ₃₀	37.3	4.6	7.6	8.1	4.8	4.7	2.4	11.9
K ₄₀	37.1	4.6	7.3	8.2	4.6	4.7	2.4	11.8
K ₅₀	36.1	4.5	7.2	7.9	4.6	4.7	2.3	11.8
K ₆₀	36.1	4.5	7.1	7.8	4.5	4.7	2.3	11.7
K ₇₀	35.5	4.5	6.8	7.8	4.4	4.6	2.3	11.3
K ₈₀	32.8	4.5	6.7	7.7	4.3	4.6	2.2	11.3
CD at 5%	1.2	NS	0.5	NS	NS	NS	NS	NS

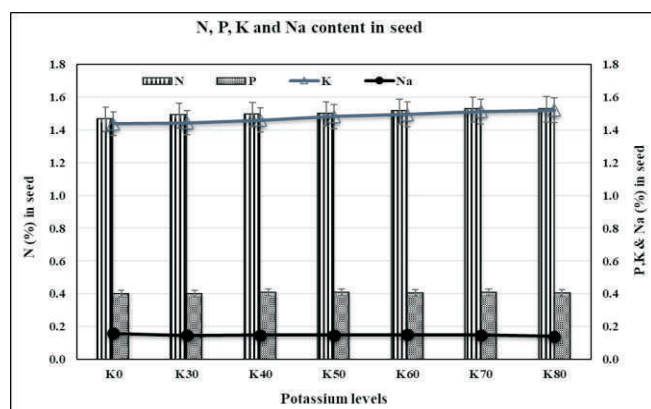


Fig. 1. Effect of potassium on macronutrient and Na content in coriander seed.

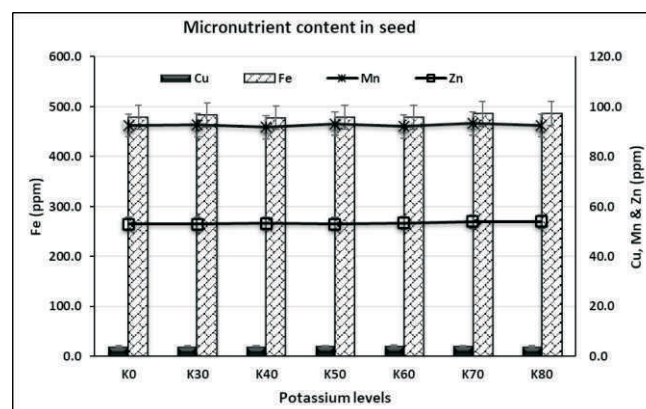


Fig. 2. Effect of potassium on micronutrient content in coriander seed.

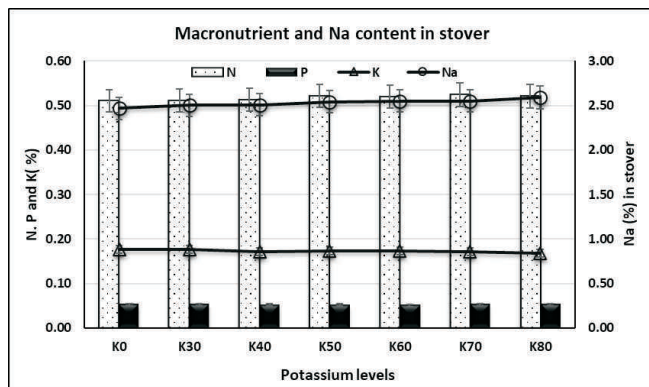


Fig. 3. Effect of K levels on macronutrient and Na content in coriander stover.

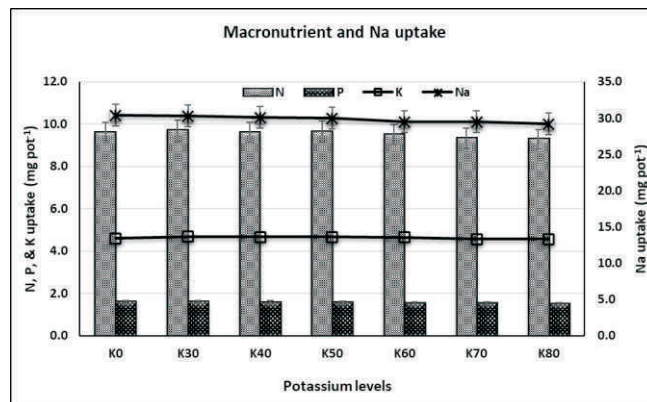


Fig. 5. Effect of K levels on macronutrient uptake in coriander.

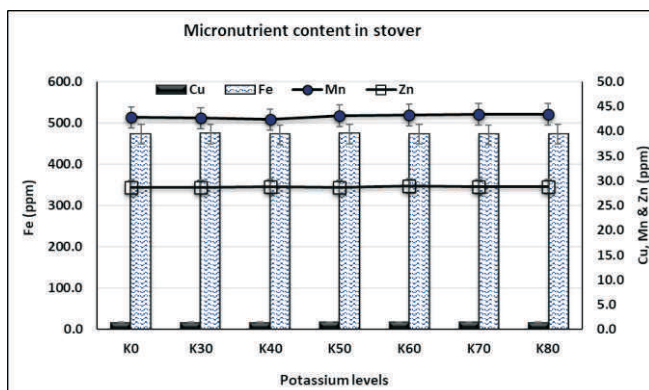


Fig. 4. Effect of potassium on micronutrient content in coriander stover.

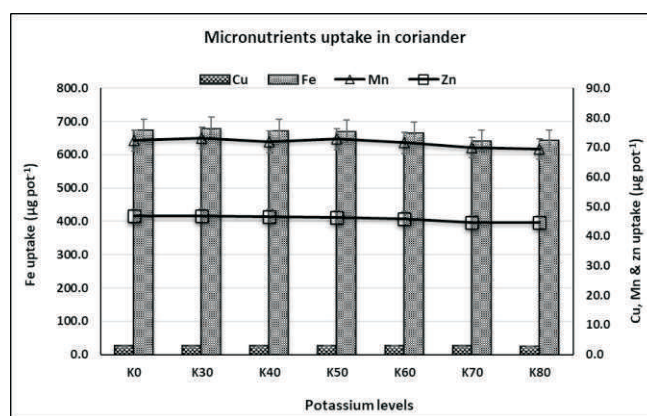


Fig. 6. Effect of K levels on micronutrient uptake in coriander

Table 2. Effect of potassium application on soil parameters after coriander crop.

Treatments	1:2 (Soil :Water)		Macronutrients (kg ha ⁻¹)			Micronutrients (kg ha ⁻¹)				Exchangeable Na (kg ha ⁻¹)
	EC (dSm ⁻¹)	pH	N	P	K	Cu	Fe	Mn	Zn	
K ₀	0.32	8.25	99.5	8.2	239.7	1.78	9.88	15.8	1.52	557.1
K ₃₀	0.31	8.25	99.9	8.2	250.7	1.78	9.75	15.6	1.55	558.0
K ₄₀	0.33	8.23	99.9	8.3	260.8	1.76	9.75	15.5	1.52	558.8
K ₅₀	0.33	8.22	100.8	8.1	268.2	1.74	9.62	15.4	1.57	566.9
K ₆₀	0.32	8.24	102.0	8.1	274.7	1.72	9.56	15.1	1.57	572.1
K ₇₀	0.34	8.24	102.9	8.1	275.7	1.77	9.55	15.2	1.53	574.4
K ₈₀	0.33	8.24	103.7	8.0	280.5	1.73	9.50	15.5	1.52	575.0
CD at 5%	NS	NS	NS	NS	24.8	NS	NS	NS	NS	NS

Conflicts of Interest : The authors declare no conflicts of interest.

References

Aishwath, O.P. and Anwer, M.M. 2016. Macro-nutrient requirement and uptake distribution in some important cultivars of coriander for nutritional budgeting. *Int J Seed Spi.*, 6(1):11-16.

Aishwath, O.P., Mehta, R.S. and Lal, G. 2018. Effects of on-farm composted seed spices residues on coriander, nutritional parameters and seasonal carbon offset by the crop and soil. *Int J Seed Spi.*, 9(1):91-99.

Bhoya, S.A. 2008. Effect of land configuration and different levels of potash and sulfur on growth and

- seed yield of coriander (*Coriandrum sativum* L.), M.Sc. (Agri.) thesis submitted to Navsari Agricultural University, Navsari. 2008.
- Bray, R.H. and Kurtz, L.T. 1945. Determination of total, organic and available form of phosphorus in soils. *Soil Sci.*, 59:39-45.
- Chapman, H.D. and Pratt, P.F. 1962. *Methods of analysis for soil, plant and water*. Division of Agricultural Sciences, University of California, California.
- Cocharn, W.G. and Cox, G.M. 1987. *Experimental designs, Second Edition*, John Wiley and Sons, New York.
- Florence, A., Ransom, M. and Mengel, D. 2017 Potassium Fixation by Oxidized and Reduced Forms of Phyllosilicates. *Soil Sci Soc America J.*, 81(5):1247-1255.
- Jackson, M.L. 1973. *Soil Chemical Analysis*, Prentice-Hall of India, Pvt. Ltd., New Delhi.
- Lindsay, W.L. and Norvell, W.A. 1978. Development of a DTPA soil test for zinc, iron, manganese, and copper. *Soil Sci Soc America J.*, 42:421-428.
- Luaza, G., Brevendan, R. and Paloma 1996. Coriander under irrigation in Argentina. In: Janick, J. (Ed) *Progress in New Crops*. ASHS Press, Arlington, VA, 590-594
- Mishra S.P., Sahu, G.S. and Hossain, M.M. 2016. Effect of Nitrogen and Potassium on Growth and Yield of Coriander (*Coriandrum sataivum*). *Int J Appl Sci Agric.*, 2(6):22-26.
- Mitra, R.S.K., Sadhu, M.L. and Bose, T.K. 1990. *Nutrition of vegetable crops*, Naya Prokash, Calcutta, 700006, India pp 157-159.
- Monali, D.A., Polara, K.B., Ribadiya, T.R., Vadaliya B. M., and Vekariya, L.C. 2019. Effect of potassium and zinc on growth, yield and quality of coriander (*Coriandrum sativum* L.). *Int J Chem Stud.*, 7(4):292-295.
- Moniruzzaman, M., Rahman, M.M. and Sirajul Karim, A.J.M. 2014. Response of coriander seed crop to nitrogen, phosphorus, potassium and sulfur fertilization. *Bulletin of the Institute of Tropical Agriculture*, Kyushu University, 37(1):73-83.
- Murrell, T.S., Mikkelsen, R.L., Sulewski, G., Norton, R. and Thompson, M.L. 2021. Improving Potassium Recommendations for Agricultural Crops (ISBN 978-3-030-59196-0 ISBN 978-3-030-59197-7 (eBook) <https://doi.org/10.1007/978-3-030-59197-7>. Pub. Springer Nature Switzerland AG. Gewerbestrasse 11, 6330 Cham, Switzerland.
- Olsen, S.R.I., Cole, C.V., Wantanable, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *U.S. Department of Agriculture Circular*, 10:939.
- Piper, C.S. 1966. *Soil and plant analysis*, Asia Publishing House, Bombay.
- Richards, L.A. 1954. Diagnosis and improvement of saline-alkali soils. *Agriculture Hand book*, U.S. Department of Agriculture, 60:160-200.
- Sadanandan, A.K. 1998. All India coordinated Research Project on spices. In: *50 years of Horticultural Research, ICAR, New Delhi* (Eds) S. P. Ghosh, P.S. Bhatnagar and N. P. Sukumaran. pp207-214.
- Sadanandan, A.K. 1993. Potassium in soils growing black pepper (*Piper nigrum* L.) and response of applied potash. In: *Potassium for Plantation Crops*, (Eds) Mahatim Singh and M.K. Mishra. Potash Research Institute of India, Gurgaon, Haryana. pp75-88.
- Singh, M. 2011. Effect of vermi-compost and chemical fertilizers on growth, yield and quality of coriander (*Coriandrum sativum* L.) in a semi-arid tropical climate. *J. Spices Aromat. Crops*, 30(1):30-33.
- Singh, R.S. and Shyampura, R.L. 2004. Soil resource appraisal, research farm of ICAR-NRCSS, Ajmer. *ICAR-NBSS Technical Bulletin*, pp. 3-9.
- Solanki, J.N., Javiya, P.P., Savaliya, N.V. and Hirpara, D.S. 2017. Response of coriander (*Coriandrum sativum* L.) to different levels of potassium and sulfur. *Int J Chem Stud.*, 5(5):1884-1887
- Subbiah, B.V. and Asija, G.L. 1956. A rapid procedure for the estimation of available nitrogen in soil. *Curr Sci.*, 25:259 - 260.
- Tripathi, M.L. 2006. Effect of potassium and sulphur levels on yield and uptake of N, P and K by coriander. *Crop Res.*, 32(3):370-371.
- Tripathi, M.L., Trivedi, S.K. and Yadav, R.P. 2009. Effect of irrigation and nutrient levels on growth and yield of coriander (*Coriandrum sativum* L.). *Indian J Agron.*, 54(4):454-458.
- Walkley, A. and Black, I.A. 1934. Estimation of soil organic carbon by the chromic acid titration method. *Soil Sci.*, 37:29-38.
- Yousuf, M.N., Brahma, S., Kamal, M.M., Akter, S. and Chowdhury, M.E.K. 2014. Effect of nitrogen, phosphorus, potassium and sulphur on the growth and seed yield of coriander (*Coriandrum sativum* L.). *Bangladesh J Agric Res.*, 39(2):303-309.